Perceptions of Air Pollution and Health in Social and Geographical Contexts

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ABSTRACT

Air quality management is currently receiving attention in the UK, with limit objectives for air pollutants to be met within the next few years. Local authorities must put strategies in place in order to meet these objectives, and this must be done with public consultation. At present, policy decisions rely heavily on scientific and medical information, which is uncertain. This thesis examines the public view of air quality and air pollution, and its impacts on their lives and health, in different neighbourhoods in the London Borough of Barnet.

The study takes place in four areas, contrasting in terms of levels of ambient air pollution, and in terms of socio-economic characteristics. In choosing contrasting areas, the research aims to examine the role of context in terms of social and geographical factors, in shaping people's perceptions and experience of air pollution and its effects.

In doing so, air pollution is conceptualised as an environmental risk, and tensions between naïve realist and constructionist framings of risk and its significance become important. Concepts of environmental equity are also considered.

As well as examining understandings of air pollution and its potential health effects, the research looks at how such lay knowledge is formed, through both personal experience and the use of expert-produced information and institutional information sources. The relationship between lay knowledge and expertise is discussed and the latent significance of epistemological divergence considered.

The research employs a mixed methodology comprising qualitative and quantitative techniques. A first stage of depth interviews, analysed qualitatively, is followed by a questionnaire survey which is analysed using statistical techniques. The epistemological implications of using such a research design are debated, and the possible benefits of using such a strategy are reflected on in the light of the empirical study.

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List Of Abbreviations

AQMA	Air Quality Management Area
BSE	Bovine Spongiform Encephalitis
CO	Carbon monoxide
COMEAP	Committee on the Medical Effects of Air Pollution
CJD	Creuzfeldt-Jakob Disease
DEFRA	the Department for Environment, Food and Rural Affairs
DETR	the Department for Environment, Transport and the Regions
EU	European Union
GIS	Geographical Information Systems
LAQM	Local Air Quality Management
NAQS	National Air Quality Strategy
NETCEN	National Environment Technology Centre
NO	Nitrogen oxide
NO2	Nitrogen dioxide
NOx	Nitrogen oxides collectively
SO2	Sulphur dioxide
PM10	Particulate matter (diameter less than 10 microns)
ppb	Parts per billion
SIEPH	South East Institute for Public Health
WHO	World Health Organisation

CHAPTER 1

Introduction

1.1 WHY THIS THESIS, AND WHY NOW

"Clean air is an essential ingredient of a good quality of life. People have the right to expect that the air they breathe will not harm them". (Department for Environment, Transport and the Regions 2000).

This quote is from the current version of the UK National Air Quality Strategy. It is simple, yet it embraces important concepts. There is the explicit assertion of the connection between air quality and quality of life. There is an emphasis on people's own expectations. Unstated but implicated are questions of how such expectations should be formed, on the basis of what sort of evidence and information.

This thesis is about lay people's understanding of air pollution, its nature, how it affects them and whether or not it harms them. It addresses how these understandings are formed, and what kinds of knowledge count in their formation. It also looks at whether context, in terms of social and geographical circumstances, has a relationship with these understandings of air quality, its nature and its effects.

Air quality and its regulation are currently receiving much attention in the UK and across Europe. The UK Environment Act 1995 introduced a radical shift in air quality policy, away from source control policies and toward both source and effects based control (Longhurst 2003). It also introduced for the first time the concept of basing air quality objectives on human health effects. The Act obliged the Secretary of State to publish an Air Quality Strategy as soon as possible. The first National Air Quality Strategy was published in 1997, and a reviewed, updated version in 2000. The strategy states its objective as being "to make sure everyone can enjoy a level of ambient air quality in public places which poses no significant risk to health or quality of life" (DEFRA 2000:12). The standards set in the National Air Quality Strategy are derived from recommendations from the Expert Panel on Air Quality Standards and are set "purely on the basis of scientific and medical evidence" (2000:29) with consideration of economic efficiency and practicability. The standards set are for zero or minimum risk levels of pollutants. The strategy acknowledges that there is scientific uncertainty, and takes a precautionary approach where this is the case.

The Strategy sets objectives for 8 pollutants (see table 1.1), with timescales in which these should be met. These pollutants are: lead, carbon monoxide, benzene, sulphur dioxide, 1,3 butadiene, nitrogen dioxide, PM10 and ozone. The objectives and timescales are set out in appendix 1. The timescales range from December 2003 to December 2010. The air quality regulations for the purposes of local air quality management do not include ozone, as sources of ozone are largely outside the UK.

The E.U. Air Quality Framework and Daughter Directive was agreed in 1998 and came into force in 1999. This set limits for lead, nitrogen dioxide, PM10 and sulphur dioxide.

The limits corresponded to those in the UK 1997 strategy, with some greater leeway in timescale, except for NO2 where the 1 hour mean limit concentration was set lower, but with a longer timescale for achievement (2010). The 2000 UK revised strategy shortened the timescale for the achievement of objectives for benzene, 1,3-butadiene, carbon monoxide, and lead, and also set a lower hourly mean target for nitrogen dioxide than had the 1997 strategy. The 1997 standard for PM10 was deemed unrealistic, and replaced by the limit values set in Europe.

The NAQS sets out a range of measures and policies at national level designed to reduce emissions of regulated pollutants. This would be expected to be sufficient for objectives to be met for all pollutants except NO2, PM10 and in some cases SO2, where local action would be needed.

Table 1.1: The principal UK air pollutants, their sources and health implications

Pollutant	Source	Potential health concern
Sulphur Dioxide SO2	Principal UK source is the burning of fossil fuels in power stations. The burning of coal for domestic heating also contributes. Levels have fallen for the last 40 years as coal burning declined.	Can cause coughing and decreased lung function. Effects worse when other pollutant concentrations are high, particularly PM10
Particulate matter (particles) PM10 - airborne particles with a diameter less than 10μm. Can vary widely in chemical and physical composition.	Principal source in cities is traffic emissions, particularly from diesel vehicles. Other sources include power stations, industry and domestic burning of wood and coal.	PM10 particles are small enough to penetrate deep into the lungs and cause inflammation. May also carry other surface-absorbed carcinogens into the lungs.
Carbon Monoxide CO	Principal UK source is road traffic.	Interferes with oxygen absorption into the bloodstream.
Nitrogen oxides NOx – comprising **Nitrogen oxide NO and Nitrogen dioxide NO2**	Principal UK source is road traffic. Other sources include power stations and industry.	NO2 can irritate the lungs and cause reduced resistance to respiratory infections.
Ozone O3	Ground level ozone is produced by a reaction between NO2 and hydrocarbons in sunlight. Levels tend to be higher in rural areas and on sunny, still days.	Irritates the lungs and airways.
Benzene	Principally from petrol combustion.	Carcinogenic.
1,3 Butadiene	Principally from petrol and diesel combustion, also some industrial processes.	Carcinogenic; may cause problems in the liver, kidneys, reproductive and nervous systems.
Lead and Heavy Metals	Principal source of airborne lead is petrol combustion. Also metal processing industries and waste incineration.	Toxic in even very small amounts. Lead linked to impaired mental function in children and foetal health damage.

Sources: National Air Quality Information Archive (undated website) and DEFRA (2002).

The Environment Act 1995 also introduced local air quality management (LAQM). Up until this time, the responsibility for air quality regulation and control had rested with central government agencies. However, under the concept of Local Air Quality Management, local authorities are required to review and assess air quality, to identify where objectives would not be met, and to designate any areas exceeding the objective to be an Air Quality Management Area (AQMA). It is further required that they should draw up action plans for how objectives would be met within the AQMAs within a specified timescale.

Thus air quality management currently involves many complex issues. Highly specialised physical science and mathematical modelling are involved in the review and assessment of air quality, and many uncertainties are contained within the models. There is uncertainty in medical science and epidemiology about the possible health effects of various air pollutants and the levels at which effects may be felt. The standards to which management strategies must work are therefore subject to ongoing review both at the UK and European levels. Local air quality management, in setting air quality management areas and drawing up policies for achievement of objectives, must take into account issues of planning, transport, economic development, public health and social inclusion.

Uncertainty is therefore involved at several stages and decisions must be made which are by nature political. The validity of knowledge for policy making becomes an issue, as does the notion of risk. At the same time, the political climate is shifting towards a style of governance that favours increasing citizen involvement in certain kinds of planning and environmental decision making, particularly at the local level. Indeed, the 1997 National Air Quality Strategy requires that local authorities must consult citizens in drawing the boundaries for Air Quality Management Areas and in developing management plans for the achievement of the air quality objectives. This is one reason why understanding the public's view of the risk is crucial.

Nevertheless, many of the relevant areas of uncertainty and indeterminacy are less open for public debate. Air pollution modelling requires expertise which is very specialised and not generally under public scrutiny. Health and medicine are also relevant areas which as yet are not particularly open to citizen challenge. In these spheres of knowledge, the public's contribution is arguably traditionally seen as less valuable. This is however a notion which is being challenged by several new 'science in society' type outreach and public engagement programmes (e.g. the Royal Society 2003; the Wellcome Trust 2003) and by academics and researchers in the public understanding of science, or 'public engagement in science and technology' as the field is now becoming known.

Air pollution therefore also makes an interesting case study from an academic and theoretical point of view. The fields of environmental risk and the public understanding of science have become much closer and more intertwined in recent years. However, much of the literature in this field has been built on empirical studies of cases of conflict between communities and institutions, such as over the siting of waste incinerators (e.g. Hunter and Leyden 1995; Shriver 1998), or the local impact of radioactive fall-out (Wynne 1992a; 1996); or where crises of governance have occurred such as over BSE (e.g. Jasanoff 1997; Jacob and Hellstrom 2000) and more recently the combined MMR vaccine (Raithatha *et al.* 2003; Hobson-West 2003). Such studies have sought to explain why and how such situations end in apparently unbridgeable divides between the expert or institutional view and the view of the affected public, and what such divides might signify. Air pollution, however, may certainly be seen as an environmental health risk, but it is one which has not to date been the subject of significant or sustained conflict. In addition, it has not for some time been subject to major NGO campaign. In general, air pollution of the kind that we find in major UK cities today, is a diffuse hazard, suffered to some extent by everybody, and contributed to by most people. The producers and the victims are not clear. The beneficiaries are also not clear: a large proportion of this type of pollution is produced by traffic, which is an integral part of all our lives even if we do not drive ourselves. Nevertheless, the distribution of the burdens and benefits is unlikely to be equal. Air pollution, since the widespread introduction of zoned bans on smoke-producing domestic fuel, has also happened gradually in recent decades. It has not been suddenly imposed. It has also not, since the 1950s, reached such proportions that many people have been badly affected by it in an acute way. On the whole, it is a low-key kind of risk which people live with and accept on an everyday basis. Thus the feelings of the public towards the risk and particularly towards experts and managers in the context of the risk may or may not show similar themes to other documented risk situations.

1.2 THE CONTRIBUTION OF THE THESIS

This thesis will bring together some diverse conceptual and theoretical areas to understand public perceptions of air pollution and its effects, and will use the empirical study to reflect back on the adequacy and scope of these concepts.

First of all, the area of environmental risk is used as a grounding concept. Air pollution is an environmental health risk in that people are exposed to it in their environment and the effects of this exposure are uncertain, particularly with respect to their health. Social theories of environmental risk have, since the 1970s, sought to explain how experts and lay people frame and understand such risks, why some risks seem to cause more worry than others, and what might be the important characteristics of risk situations that shape people's responses (e.g. Fischoff *et al.* 1978; Douglas and Wildavsky 1982; Slovic 1987; Kasperson *et al.* 1988).

The field of social studies of risk has since the early 1990s reached similar concerns and agendas to that which has become known as the public understanding of science. An important component of risk conflicts has become recognised as being the relationship between public understanding or lay knowledge on the one hand and institutional understanding and expertise on the other (e.g. Szerzynski *et al.* 1996; Irwin 1995; Wynne 1992b). The second theoretical area which this thesis therefore draws on is that which has examined relationships between lay and expert knowledge with respect to risk and the environment. The relationship between public understanding and expertise in this empirical situation in question will thus be analysed and reflected on in the light of such work.

Relationships between lay and expert knowledge in the field of health are also relevant and this has tended to be a somewhat separate literature although there are clear conceptual parallels. In this thesis I also take the concept of 'lay epidemiology' and use work on lay knowledge in public health situations to help understand public perceptions of air pollution and health. I examine whether there is a clear lay epidemiology of air pollution and what it might be, and how this relates to the current scientific view.

Work on environmental equity has been concerned with the idea that hazards and risks are not evenly distributed and that some people bear a disproportionate amount of the burden; these people are usually people who are already socially and materially disadvantaged (e.g. Lavelle 1994; Cutter 1995). This is an important way in which context becomes part of the nature of the risk problem. As well as being social, this is explicitly geographical as it is the spatial distribution of hazards that has normally been of concern. The field of environmental equity and environmental justice studies has been dominated by spatial mapping techniques as a way of understanding hazard and risk distribution. In this work I take up the concept of environmental equity in relation to air pollution as a tool in understanding the geographical context of the risk, but also ask how a different methodological and conceptual approach with an emphasis on perceptions and experience might add to the understanding of environmental equity.

Previous work on perceptions of air pollution has made some interesting empirical and theoretical contributions which are useful to take into account. However this thesis goes further than previous work in examining the nature of people's perceptions of air pollution and in particular its impacts on their health and lives.

In particular the concept of context is integral to this thesis. The treatment of context, especially geographical context, in relation to the public understanding and experience of environmental health risk has been piecemeal and scant in research to date. Geography has made some contributions as I shall discuss later, but approaches have been disparate and somewhat incoherent. This thesis aims to make a useful contribution in this conceptual area.

Thus the contribution of this thesis will be in understanding the nature and content of public perceptions and understandings of air pollution and its impacts on their lives and health. This is of crucial importance given the current state of air quality management in the UK and its stated aims. The thesis will also shed useful and practical light on how people form their understanding and what the relationships with institutional information and expertise are. Theoretically the thesis will have relevance to social theories of risk in examining a current situation which is not at present in a state of crisis or conflict. This study aims to make an original contribution to studies of environmental health risk in taking seriously the role of social and geographical context in understanding risk perceptions. It will contribute to current work and debates on environmental equity and how such debates should be framed. Linked to this, although not within the scope of this thesis in depth, is work on geographical health inequalities to which this study may be of some relevance through its contribution to environmental equity issues.

Lastly, this thesis makes a contribution to current methodological debates in the social sciences. In this work I use a 'mixed methodology', employing both qualitative and quantitative techniques. A substantive interest of this work is in how using such a combination of techniques may be useful in understanding public understandings in a policy-relevant way, and what the benefits and drawbacks may be of each kind of techniques, and in particular their combination.

1.3 THE STRUCTURE OF THE THESIS

In the remainder of **Chapter 1**, as important context before moving on to the main study, I present a summary of current medical knowledge on the health effects of traffic-related air pollution, and the current UK government health advice relating to air pollution. I concentrate on traffic-related pollutants as these are of principal concern in UK cities and in local air quality management, and it is these pollutants which are of most relevance to the public perceptions in which I am interested.

Chapter 2 presents and critiques the conceptual approaches which this study is taking as a theoretical basis. This starts with setting out some important social theories of environmental risk which have underpinned the development of this field. I then turn to work on environmental equity, which has been particularly interested in the distributional aspects of risk. Here I concentrate on environmental equity with respect to air pollution and critique the ways in which it has been conceptualised and operationalised. I then briefly discuss some concepts from health geography that offer potentially useful and alternative ways of conceptualising the role of geography in public health risk situations. Next, I move on to discuss some more recent work in the field of risk which has highlighted and analysed the relations between lay knowledge and expertise in environmental risk situations. I also bring in some work on lay knowledge in the field of public health, and particularly work which has used the concept of 'lay epidemiology'. Lastly in this chapter, I review and critique work which has taken perceptions of air pollution as its substantive interest, moving from early empirical work in the 1960s through to more recent work which has been more theoretically developed but still disparate. The concluding comments lead to the formulation and setting out of my research questions.

Chapter 3 discusses the methodological strategy behind the empirical study. First, I consider debates surrounding the use of mixed methodology and the epistemological and ontological implications of such a research design. Following this, I present the procedure followed in carrying out the research, from the selection of a geographical location, through the process of conducting and analysing the in-depth interviews, to the development, administration and analysis of the postal survey. This presentation includes discussion of the choices of strategy made as the research proceeded, and the benefits, implications and limitations of the choice of approach taken.

Chapter 4 is the first of three chapters presenting the empirical results of the study. In all three of these chapters, material from both the qualitative and quantitative stages of fieldwork are presented in parallel. This chapter presents and analyses in detail results from the study which relate to the research participants' perception of air quality both in their locality and in London. It examines how some other contextual factors might affect these perceptions and what the implications of this are. In this chapter I also examine what people understand the nature of air pollution to be, in terms of its causes and sources. Finally in this chapter I discuss the importance of air pollution to the people taking part in the research, in both actual and relative terms, and again look at the role of context in this.

Chapter 5, the second chapter of empirical results, is about how people experience the impacts of air pollution. This relates largely to the perceived health effects which I present in some detail. These include understandings of the potential of air pollution to affect health in general, and the perceived health effects on the participants themselves and on those close to them. Other non-health impacts are also discussed. This chapter goes on to look at how people may or may not make behavioural changes in order to cope with air pollution. Again, the role of context in experiencing the impacts of air pollution is discussed.

Chapter 6 presents analysis regarding how lay people appear to form their knowledge about air pollution and its effects. This covers the perceptions discussed in both the previous chapters, about the presence or absence of air pollution, its importance, and the effects it might have on health and well-being. The use of different kinds of knowledge from different sources is analysed. Here I discuss the apparent relationship with expertise and institutions and the implications of this in the light of previously discussed theoretical work.

Chapter 7 concludes the thesis. In this chapter I draw conclusions about what the lay perceptions of air pollution and its effects were found to be. I discuss the role of social and geographical context in various ways and which kinds of context appear to matter most. The implications of the effects of context for debates on risk and equity are argued. This chapter covers the relevance of this work to theories of risk and to work about relations between different kinds of knowledge. I also return to a discussion of the methodological strategy and its benefits and limitations in the light of the empirical work.

1.4 CURRENT SCIENTIFIC KNOWLEDGE REGARDING THE HEALTH EFFECTS OF TRAFFIC-RELATED AIR POLLUTION

There is a huge body of research on the health effects of various air pollutants, which it is not within the scope of this thesis to review in detail. The following is a summary of some current scientific research with regard to the main traffic-related pollutants, and its interpretation by UK health policy makers.

1.4.1 Health conditions

Respiratory complaints

Many studies in different locations in the developed world have consistently found an effect of long term exposure to air pollution and / or traffic on respiratory symptoms (including wheeze and cough) and lung function, particularly in children (e.g. Hirsch *et al.* 1999; Oosterlee *et al.* 1996; Ciccone *et al.* 1998; Wjst *et al.* 1993; Braun-Fahlander *et al.* 1997; Studnicka *et al.* 1997; Nicolai *et al.* 2003; Brauer *et al.* 2002) – although some have not (e.g. Stern *et al.* 1989 in Canada). Living in high traffic density has been connected to respiratory hospital admissions of all ages in Canada (Buckeridge *et al.* 2002). In the UK, children living close to a major road showed clearly raised levels of wheeze symptoms (Venn *et al.* 2001) though this relationship had not previously been found in the same data when a larger unit of living area was used (Venn *et al.* 2000).

Asthma as a particular form of respiratory disease has been connected with air pollution and traffic exposure in various studies. In addition to the studies above, most of which included wheezing as symptoms, for example, childhood asthma hospitalisation and medical care in the US has been associated with living by roads of heavy traffic (Lin *et al.* 2002; English *et al.* 1999) and with exposure to PM2.5 and carbon monoxide (Norris *et al.* 1999). Asthma in children was related to concentrations of traffic and of related air pollutants residentially for children in the Netherlands (Brauer *et al.* 2002). Nicolai *et al.* (2003) in Germany associated asthma with soot (a form of particulates) and benzene, and with high traffic counts, although they could not rule out socio-economic factors associated with living by busy roads as an explanation or mediator. However not all studies concur: for example a French study found asthma related to ozone only, but not even this when family history and socio-economic status were accounted for (Ramadour *et al.* 2000), and in Norway SteenJohnsen *et al.* (1995) found no difference in the prevalence of asthma in schoolchildren between different pollution zones – in fact the prevalence was highest in the minimal zone. Still, according to a recent editorial in the European Respiratory Journal, data is accruing suggesting that asthma prevalence may to some extent be determined by air pollution, particularly traffic-related pollution (Brunekreef and Sunyer 2003). Wilkinson (2002), in a summary of epidemiological studies on air pollution and asthma, concluded that there was evidence of small effects of pollutants in triggering or worsening attacks, and such associations were generally strongest for ozone and particles, but that ambient air pollution is not a convincing explanation for long term trends in asthma prevalence.

The question of whether or not air pollution can cause asthma is still contentious. Most recently, McConnell *et al.* (2002) for instance found that children exercising in high ozone levels developed more asthma. Brunekreef and Sunyer commented that this was 'another piece of evidence that makes the respiratory field more hesitant to say that air pollution does not induce new asthma cases' (2003:913). Wilkinson's (2002) summary concluded that the evidence of air pollution inducing asthma is mixed, but interestingly that the distinction between exacerbation and induction may be artificial: just as pollution may make existing asthma worse, by the same mechanism it may induce diagnosable asthma symptoms in someone who had the potential to develop them, but who would not have done so to a noticeable degree in non-polluted circumstances.

Heart disease

Coronary heart disease, congestive heart failure, and heart rhythm disorders have all been identified as increasing vulnerability to the effects of air pollution (Annesi-Maesano *et al.* 2003). Particulates have been particularly implicated (Brook, Brook and Rajagopalan

2003). For example, elderly people have been found to have decreased heart rate variability after exposure to particulate pollution (Devlin *et al.* 2003); cardiac symptoms were found to be related to PM2.5 concentration in elderly patients with coronary heart disease in 3 European cities (De Hartog *et al.* 2003); and PM10 and black smoke levels have been related to cardiac hospital admissions in a study of 8 European cities (Le Tetre *et al.* 2002). Other traffic-related pollutants are also believed to have an effect: for example carbon monoxide and NO2 have been associated with hospital admissions for ischaemic heart disease and congestive heart failure in California (Mann *et al.* 2002).

Allergies

Experiments on animals and on human tissue have indicated that exposure to diesel exhaust may affect allergic sensitisation (Takano *et al.* 1997; Miyabara *et al.* 1998; Devalue *et al.* 1997; Diaz-Sanchez 1997; Diaz-Sanchez *et al.* 2000). Traffic-related pollutants have been suggested to increase allergic sensitisation to pollen (Knox *et al.* 1997; Behrendt *et al.* 1997). A recent study associated high traffic volume exposure with increased allergic sensitisation in children who were also exposed to tobacco smoke, although no single pollutant was associated (Nicolai *et al.* 2003). Ring *et al.* (2001) reviewed a collection of data and concluded that 'type II' pollution characterised by NOx, ozone, particulates, diesel exhausts and tobacco seems to enhance allergic disease, but that 'type I' pollution – SO2 and dust – does not. Other studies on children however have found no relationship between allergy symptoms and traffic or pollutant exposure (e.g. Hirsch *et al.* 1999; Wjst *et al.* 1993; Studnicka *et al.* 1997).

Taking rhinitis specifically, there have been relatively few studies and the results are again mixed. A recent study in Taiwan concluded that traffic-related air pollution, probably mediated through exposure to other common allergens, was a possible risk factor for allergic rhinitis in schoolchildren (Lee *et al.* 2003). A German study linked high SO2 and intermediate particulate and NOx levels with runny nose and cough (von Mutius *et al.* 1995). Rhinoconjunctivitis symptoms have been linked with raised ozone, NO2 and possibly PM10 (Riediker 2001) and GP consultations for allergic rhinitis have been associated with levels of ozone and SO2 (Hajat *et al.* 2001). However, other work in France has found no link between allergic rhinitis and pollution levels (Ramadour 2000).

Eczema and related skin complaints

Environmental factors, in interaction with genetic and other factors, are thought to play a part in the development of skin irritations such as eczema and dermatitis and as such, traffic-related air pollutants have been implicated in the increase in such conditions in recent decades. As eczema is often associated with the occurrence in the individual of asthma and other allergic and auto-immune reactions, it seems likely that levels of pollution could also be associated with its onset or exacerbation.

Again, the evidence is mixed. Work done in Germany after the Berlin Wall fell found significantly higher rates of atopic eczema in the East than in the West; in one study eczema was found to be significantly associated with living near a road with heavy traffic, among other factors (Ring *et al.* 1999). However, further recent research does not strongly support such an association. Brauer *et al.* (2002) observed no positive associations between air pollutants and eczema or skin rash. Werner *et al.* (2002) found that atopic dermatitis was associated with a privileged lifestyle but not with environmental factors in Germany. Similarly Yura and Shimizu (2001) in Japan found a negative correlation between atopic dermatitis and air pollution, but a positive correlation with income.

The National Eczema Society (undated website) state merely that 'the causes of certain types of eczema remain to be explained, though links with environmental factors and stress are being explored'.

Long term effects on life expectancy

The UK Department of Health Committee on the Medical Effects of Air Pollution (COMEAP) conclude that the scientific evidence suggests that exposure to air pollution has a long term effect on health, and that for instance if life-long exposure to fine particles was reduced by 50%, life expectancy could be increased on average by 1-11 months (Department of Health 2000). The World Health Organisation (1999) cite 2 pieces of evidence on long term effects: a study from the Netherlands which concluded that exposure to current Netherlands levels of air pollution may lead to an average reduction in lifespan of one year; and US evidence that individuals in polluted communities may on average live 2 years less than those in unpolluted communities.

Foetal growth effects

There is some evidence that maternal exposure to particulate pollution during pregnancy may retard foetal growth and development (Dejmek *et al.* 1999; Perera *et al.* 1999 cited in Samet *et al.* 2001) although this area of research does not seem to have been much pursued.

1.4.2 The UK Official View

The UK Committee on the Medical Effects of Air Pollution (COMEAP), serving the Department of Health, conclude that "for the most part, people will not notice or suffer from any serious or lasting ill effects from levels of pollution that are commonly experienced in the UK, even when levels are described as 'high' or 'very high' according to the current criteria" (Department of Health 2000:2). They state however that air pollution can worsen the condition of those with heart or lung disease, and can aggravate, but does not appear to cause, asthma. They add that long term exposure also probably results in some reduction in life expectancy.

The Department for Environment, Food and Rural Affairs (DEFRA 2002) give a similar view, but additionally say that during high pollution episodes, some people may experience eye irritation, or a cough, or find that breathing deeply is uncomfortable.

In their 1998 report 'The quantification of the effects of air pollution on health in the United Kingdom' COMEAP estimated the numbers of deaths from all causes brought forward, and hospital admissions from respiratory conditions, either brought forward or additional, which could be attributed to the effects of air pollution (Department of Health 1998). Estimates were made separately for the effects of particles (PM10), sulphur dioxide and ozone. Reliable estimates could not be made for nitrogen oxides or for carbon monoxide due to shortage of data. Estimates for sulphur dioxide and for particles were for urban areas only, due to lack of data on rural levels.

The figures produced were as follows:

Table 1.2: estimated hospital admissions and deaths brought forward per year due to air pollution

Pollutant	Deaths brought forward p.a. – all causes	Hospital admissions from respiratory complaints, brought forward and additional p.a.
PM10 (urban)	8100	10500
SO2 (urban)	3500	3500
ozone (urban & rural)	700-12500	500-9900

The figures for ozone are a range corresponding to assumptions of a threshold effect from 0-50ppb. The report also states that additive and synergistic effects from exposure to several pollutants at once may take place which cannot at present be accounted for.

The report states that both deaths and hospital admissions are likely to occur in patients with severe pre-existing conditions. The figures are based on measures of association from various studies, but the Committee accepts a causal explanation as likely. The amount of time by which deaths are brought forward cannot be estimated, although in another report, COMEAP state that "most people studying this field believe that in general it may be a matter of weeks or months rather than years" (Department of Health 2000:2), and with respect to the hospital admission figures, it cannot be estimated how many of these are brought forward and how many are additional.

These estimates relate to effects during acute air pollution episodes. COMEAP also state the view that in addition to these estimates, long term exposure to high levels of air pollution is likely to damage health but there is insufficient data to quantify how much. Nevertheless, they say that if estimates from elsewhere, particularly the US, apply, the overall impacts may be 'substantially greater' than those estimated.

1.4.3 UK Official Health Advice

Staying indoors may not help to avoid high outdoor pollution because most pollutants penetrate indoors very effectively, apart from ozone (COMEAP 2000), although this will be facilitated by the opening of doors and windows. The Department of Health advise susceptible people to avoid vigorous exercise on days of high or very high pollution, and that people with serious heart or lung disorders, the elderly and young children should avoid roads with heavy traffic when pollution levels are high or very high. They also advise plenty of antioxidants in the diet to counteract the effects of oxidising pollutants.

In summary, it appears to be well accepted by the scientific community that traffic-related air pollution can worsen existing heart and lung conditions, including asthma. There is quite a lot of evidence but less consensus that air pollution may increase sensitisation to other allergens such as dust mites or pollen. Because of the aetiological relationship with other auto-immune disorders, particularly asthma, there is speculation that air pollution exposure may worsen or even bring on eczema and related skin complaints, but there seems to be little evidence for this at present. There is little consensus as to whether air pollution can cause asthma; the prevailing current view appears to be that there is no evidence for this at present and that in fact mounting evidence is indicating that it probably does not. However not all agree, and as Wilkinson (2002) pointed out, it may be that the distinction between causation and exacerbation is artificial – which presumably could be applied to other conditions as well.

The science, though always progressing, is therefore uncertain and contingent, but it is on this that current regulatory policy is built. This thesis will now go on to explore the public view of air pollution and its effects, with the aim of contributing to the understanding of the real situation, as it is experienced.

CHAPTER 2

Conceptual Frameworks For Understanding Perceptions Of Air Pollution In Context

This chapter presents and critiques the theoretical concepts I am using to frame the rest of the study. I start by discussing some social theories of risk, which have been very influential on later work, not least in terms of the paradigmatic and epistemological alignments. Following this, I turn to work on environmental equity, particularly that which has been concerned with air pollution. This work has been especially concerned with the uneven social and spatial patterning of risk exposure, and as such represents one important way in which the significance of context has been addressed with respect to environmental risks. I then note some important relevant contributions that health geographers have made to the understanding of the role of geographical context context in health. Next, I introduce relevant work on lay knowledges and the nature of their relationship with expertise. This brings in work from the field of environment and risk studies, and also work from the field of critical public health studies, which has significant parallels; indeed the two fields start to overlap with work using concepts of 'popular' or 'lay' epidemiology. As a last substantive area I review empirical work which has studied lay perceptions and understandings of air pollution. This covers earlier studies from the 1960s to 1980s, which often looked for relationships between perceptions and other contextual variables, and later developments from the 1990s onwards where theoretical concepts about context and lay knowledge start to be introduced. The chapter ends by formulating the research questions for the empirical study in the light of the foregone theoretical discussion.

2.1 THEORIES OF RISK

In this thesis I am conceptualising air pollution as an environmental risk. That is to say, it is an environmental hazard with at present unknown effects or consequences for any individual, for society in general, and indeed for global ecology. There are no universally accepted definitions of hazard and risk (Gerrard 2000). One useful working definition of risk, offered by Renn (1992), is "the possibility that an undesirable state of reality (adverse effects) may occur as the result of natural events or human activities".

The field of risk studies takes in many areas from system reliability to evaluation of health risks to decision research, and so is by nature multi-disciplinary. In such a multidisciplinary field, different paradigms come into play. The paradigm through which risk is defined and approached affects how it is communicated about and managed. Integration of these paradigmatic frameworks may be a goal, but often they are in conflict.

2.1.1 Technical approaches to risk

Approaches to risk embrace various 'technical' perspectives, which in practice have tended to dominate the risk management field. These are all quantitative and include, for example, actuarial approaches, epidemiology and toxicology, and probabilistic risk analysis (Renn 1992). In *actuarial* terms, uncertainty is measured by relative frequency of occurrence, on the basis of extrapolation of existing statistical information. Undesirable events are defined as observable or measurable physical harm or damage. *Epidemiological and toxicological* approaches attempt to model the relationship between possible causal agents such as toxins or environmental conditions and undesirable effects, defined as physical observable harm to health. Often correlation and statistical measures of association are used. *Probabilistic risk analysis* aims to predict the possibility of occurrence of an outcome, such as component or system failure. It is largely used in engineering for improving the overall safety of systems. Fault trees or event trees are often used, where the whole system is mapped with possible sites of failure marked so that the consequences of such failure can be pre-empted and minimised. Problems can occur in this approach in modelling human error and in ensuring that the fault tree is comprehensive. The process known as risk assessment usually combines some kind of technical analysis of consequences with an estimate of the frequency (probability) of occurrence (Gerrard 2000).

All the above technical perspectives work within a naïve realist paradigm[1], in that they assume risk to be a (potential) physical attribute that exists independent of our understanding of it, and they assume that the nature of real phenomena can be objectively established. They are also positivist. They define adverse outcomes as measurable physical harm; and they average over time, space and, where applicable, populations. Working with such approaches often leads to risk communication and management through risk comparisons. Risk comparisons assume that the risks which should receive priority for regulation or management of some form are those with the greatest probability of occurrence. Where the magnitude of consequences differ, comparison may be made by calculating the risk as magnitude multiplied by probability. Thus, as a simple example, a risk which has a one in ten chance of occurrence and could kill one person would be seen as an equivalent risk to an event which had a one in a thousand chance of occurrence, but could result in one hundred deaths if it were to occur.

This type of approach to communication is common, using risk scales such as that exemplified in the BMJ (Calman and Royston 1997), which compares various risks including road accidents, oral contraceptives and lightning on a numerical scale. Calman and Royston's scale is designed to inform the public and help them put risks into relative perspective. This is essentially a normative practice, intended to reassure the public but also to encourage them to comply with the scientific, institutional view of risk management.

[1] (Cloke, Philo and Sadler 1991) - to be distinguished from later more nuanced forms of realism, such as that of Bhaskar (1975; 1986) and Sayer (1984) which rejected positivism and incorporated some of the notions of idealism.

Such technical assessments and numerical comparisons may be part of how people process the notion of risk, but their shortcomings have been highlighted by social science perspectives. For example, such assessments ignore differences in perceptions of undesirable effects; they rely on aggregating data and overlook variation between individuals; they do not address social, psychological or cultural impacts; they ignore factors relating to institutional structures, such as trust (Slovic 1998). Multiplying magnitude by probability assumes that these two parameters are of equal weight, i.e. that a low probability risk with potentially high fatalities is equal to a high probability risk of low consequences, whereas the public may not find these to be equally acceptable.

It was largely in response to observed public reactions to risks which were not in line with the logic of the positivist view that social science studies of risk came into being, starting in the late 1960s. The technical paradigm often, still, sees public reactions to risk situations as irrational, illogical, or a consequence of lack of or mis-information. Social science perspectives, which I will go on to explore further in this chapter, have attempted to shed some light on the social rationality of risk.

2.1.2 Psychology, decision research and the 'psychometric paradigm'

One of the major social science fields to become interested in the social dimensions of risk was that of psychology and the allied field of decision research. Decision researchers in the US were interested in how people acted in certain decision-making situations which involved being faced with uncertain outcomes. Some of the early work in the 1970s using experimental psychological approaches came up with some observed 'perceptual biases'. The two best known of these are the 'Gambler's Fallacy' (Burton *et al.* 1978) and the 'Availability Heuristic' (Tversky and Kahneman 1973). The Gambler's Fallacy essentially postulates that individuals misunderstand independent probabilities, assuming that if an event has just happened it will be less likely to happen again immediately, and if it hasn't happened for a while it is 'due'. In the context of environmental risk, the 'Gambler's Fallacy' was offered as explanation of why people have moved back to homes on flood plains or earthquake faults after a flood or earthquake has just occurred.

According to Tversky and Kahneman's (1973) Availability Heuristic, individuals judge the probability of a given occurrence by the ease with which they can recall it having happened before, therefore will underestimate the risk of something of which they have no experience and overestimate the risk of events which they have recently encountered or which have a dramatic impact. This has been used as an explanation of why people react strongly to risks which have been reported in the media, such as health risks from oral contraceptives, whilst not reacting to numerically greater, but underpublicised, risks such as that from naturally occurring radon gas.

Whilst useful (although potentially contradictory), these two views tend to uphold the technocentric view that people's apparently illogical reaction to risk situations is due to a misunderstanding of the measurable, 'real' risk.

The particular approach to understanding social dimensions of risk which has come to be known as the psychometric paradigm, arose out of the research programme of Slovic, Fischoff and Lichtenstein in the 1970s and 1980s (e.g. Fischoff *et al.* 1978; Slovic *et al.* 1980; Slovic *et al.* 1985). This research was again rooted in US decision research, which this group developed into an interest in people's reactions to, and behaviour with respect to, natural hazards and technological risks.

This was an extremely important and influential development in risk research because it started from the assumption that there is no objective risk which can thus be given a real quantity. From this starting point, they sought to show that experts and laypeople do not define risks in the same way. 'Lay' or non-technical definitions of riskiness, and hence how risky any one risk is, will include social dimensions not taken account of in the technical framing of risk.

The 'psychometric paradigm' research used questionnaires to ask people directly about their perceptions of risks and benefits. This also allowed the researchers to look at a large number of risks together, in order to compare them. They used a concept from personality theory, and asked people to characterise the 'personality' of various hazards by rating them on various qualities and characteristics which had been hypothesised in previous work to influence risk perception and acceptance (e.g. from Starr 1969, Lowrance 1976, both cited in Slovic 1992). These included *catastrophic potential, voluntariness of exposure, immediacy of effect, knowledge to those exposed, controllability* and *fairness*. Researchers then used psychometric scaling methods to produce quantitative measures of risk perception. It was concluded from these activities that experts' judgements of riskiness correlated highly with fatality estimates. However, although laypeople were able to give quite accurate estimates of potential fatalities, their judgements were sensitive to other factors such as these 'personality' characteristics.

Asking people to characterise various risks resulted in 'personality profiles' for each risk which could be created by taking the overall mean score from all respondents for each 'personality attribute' for each risk (Fischoff *et al.* 1978). The research team found that many of the attributes correlated, which led them to use factor analysis to try to reduce the array of characteristics to a smaller number of dimensions which would describe the main latent variables affecting people's judgements of the characteristics of hazards. This was done in different ways in different studies but the classic, most reproduced model was one with two factors reduced from 15 original characteristics (Slovic 1987). The first factor corresponded to: not observable, unknown to those exposed, unknown to science, effect delayed, new risk - or the opposites of all these - this factor was interpreted overall as '*unknown*'. The second factor reflected the characteristics uncontrollable, dread, global catastrophic, consequences fatal, not equitable, high risk to future generations, not easily reduced, risk increasing and involuntary: this was interpreted as '*dread*'.

The mean scores for all respondents on each factor could then be plotted on two axes, which produced the classic factor space diagram (Slovic 1987). This allowed comparison of many different risks and technologies on the two factors which represented a summary of the original 15 'personality characteristics'. Lay judgements of riskiness were concluded to be related to the position on the factor space model – the higher the factor scores, the more risky the technology or hazard was judged to be; the 'dread' factor was found to be the most important however. Expert judgements, on the other hand, related to the number of possible fatalities or injuries and not the factor model.

The success of this approach is that it showed simply how expert and lay judgements of risk differed. It showed how lay judgements of risk were based on other dimensions than physical harm, and helped diagnose what these dimensions might be. Although this work has been criticised for trying to show that lay judgements of risk were wrong because biased by subjectivities (see, for example, Lupton 1999) I would not read the original work as taking this position. Rather, it was an attempt to clarify why the differences between lay and expert judgements might occur, and also why lay judgements appeared to be resistant to expert information.

However, the disciplinary approach is individualistic and, by its framing, does not address social and cultural dimensions to risk perception. In addition, the 'personality' characteristics on which people rated the risks were set and framed by the researchers so were arguably not necessarily rooted in the real concerns of individuals or groups themselves. This is related to the questionnaire methodology and, as with many questionnaires, the results are open to the criticism of being artefactual, i.e. a product of the methodology and the conceptualisations of the researchers, rather than reflecting any 'true' phenomenon.

One of the main flaws in the method of Slovic *et al.* (1985; 1987) relates to the use of factor analysis. Although used within the positivist and quantifying paradigm of cognitive psychology, factor analysis is a highly interpretative approach. Some of the characteristics will fit better onto the factors than others, and a rotation may even have been used to produce a better fitting model, although neither of these are clear in the final presented model. The interpretation of the factors is highly subjective. Clearly in this model, more (ten) of the fifteen characteristics load onto the second factor than onto the first, so it is not surprising that this factor is the most influential in judgements of risk – basically this contains a summary of two thirds of the original information. That this factor was interpreted as 'dread' gives a particular picture – dread was one of the original characteristics but then so were 'not equitable' and 'involuntary' which are hardly described by 'dread'.

A further important criticism is that the scores have been aggregated for all individuals so cannot show how individuals might differ and may give a misleading picture of the spectrum of people's views (Vlek and Stallen 1981). A later exploration of this issue by Marris *et al.* (1997) found that the relationships between risk perceptions and risk characteristics observed at the aggregate level did hold true at the individual level for most, but not all, of the characteristics. Some of the observed correlations between the characteristics might not be true at the individual level – this would potentially affect the composition of the extracted factors. Marris *et al.* (1997) also showed that risk perceptions did vary between individuals, but by how much depended on the particular risk issue being evaluated.

The original study used only 34 US university students and so could be criticised for being culturally narrow. Later studies reproducing the technique in different settings have shown differences between countries and between groups in overall risk ratings and in the ordering of risks (e.g. Slovic *et al.* 1989 in Sweden; Slovic *et al.* 1991 showing differences between different regions of Canada; Englander *et al.* cited in Slovic 1992 in Hungary). This gives some evidence of a cultural and/or institutional dimension in risk perception; however the limitations of the individualistic psychological method mean that these dimensions cannot be thoroughly explored or given theoretical depth within this approach.

2.1.3 'Cultural theory'

'Cultural theory' is a specific social theory of risk which originated in anthropology and takes a more strongly constructionist approach to risk and risk perception. It sees people as active constructors of risk meanings rather than passive receivers of risk information, and sees the ultimate root of risks and risk perceptions as lying in institutional structures (Rayner 1992).

Douglas, in her 1966 book *'Purity and Danger'*, theorised that 'danger' and 'pollution' are socially constructed categories which serve to reinforce the social, political and moral order of a society. For instance the cattle-herding Hima of Uganda believe that cattle will die as a result of contact with women, or if someone eats arable produce while drinking milk. The belief in these threats reinforces the gender division of labour and also keeps their identity distinct from the neighbouring arable farming peoples. In *'Natural Symbols'* (1970) Douglas went on to define two dimensions on which societies can be characterised. These are '*grid*', which denotes the degree to which an individual's life is circumscribed by externally imposed restrictions; and '*group*' which denotes the extent to which an individual is incorporated into social units.

Putting these dimensions as two orthogonal axes defines 4 cultural stereotypes:

- *Hierarchy* – high group, high grid: socially prescribed roles and strong group boundaries;
- *Egalitarianism* – high group, low grid: strong group boundaries but little belief in prescribed roles;
- *Individualism* – low group, low grid: no group incorporation and no prescribed rules;
- *Fatalism* – low group, high grid: low group association but a strong sense of social distinctions. This last stereotype has also been referred to as stratified or alienated individuals, rather than a specific culture (e.g. Douglas and Wildavsky 1982; Rayner 1992).

It was in '*Risk and Culture*' (1982) that Douglas, with political scientist Wildavsky, explicitly linked this typology of cultures with risk perception, a theme which developed further (Rayner 1984; Douglas 1985; Thompson *et al.* 1990). This work argues that that the organisational characteristics of institutions will lead people differentially to select some risks, or attributes of risks, for attention, while suppressing and ignoring others. For instance, hierarchies will be most concerned about risks which threaten the social order, whilst egalitarian cultures may be concerned with risks which are inequitable. Different cultural types will also accordingly prefer different management strategies and decision-making procedures (Rayner 1984); for instance individualism would promote market solutions. The fatalists are those who will tend to feel powerless and alienated.

The development of cultural theory has taken two rather distinct forms. To some extent this hinges on the question of how behaviour or perceptions in the individual may be accounted for. One school of thought argues that worldviews are context dependent (Thompson *et al.* 1990), and has tended to concentrate on the social relational and institutional levels of analysis through ethnographic approaches in single settings (e.g. Rayner 1986). This school, however, has been criticised for implying implausibly that individuals in a complex society may behave differently in different settings such as at home and at work, exhibiting an implausible degree of adaptation (Boholm 1996). Others have argued that if individuals tend to gravitate to groups of a similar culture, then cultural bias should be exhibited and therefore measurable in the individual. This development was proposed notably by Dake (1991), a psychologist who devised a psychometric style questionnaire to score individuals on each 'worldview'. This has been used to test cultural theory quantitatively, by correlation with other attitudinal questions about risk (e.g. Dake and Wildavsky 1991; Langford *et al.* 2000). However, this approach has been criticised for ignoring the institutional focus of the original theory (Rayner 1992).

Cultural theory has come under attack for being deterministic whilst, at the same time, being unclear as to whether social relations generate values or constrain them (Boholm 1996). The dimensions are indeed rather simplifying, with the classification of the 4 groups leaving little room for degrees of subtlety along the scales. Perhaps the hardest criticism to counter is that it is tautological and circular. Cultural theory cannot be proved or refuted, as what is to be proved is identical with the proof (Boholm 1996).

Another very important criticism is that the strongly social constructionist stance of the theory dangerously misses the importance of the physical reality of risks. In concentrating on the symbolic significance of risks to society, cultural theory can be taken to imply that the risks themselves are a matter of point of view, or faith. As Kaprow (1985) writes:

> "The fact that industrial pollution, like other types of pollution, exists in our heads does not negate the fact that it also lies out there. Eating vegetables with milk does not cause the Hima's cattle to die, whereas lead and formaldehyde really do ravage the central nervous system in humans ..... PCBs actually do wreak changes in vertebrate physiology, and their prohibition is not solely a society's way of building solidarity" (1985:355).

Recent empirical work on risk using cultural theory is scant and has tended to use the Dake questionnaire and so individualise the emphasis of the theory. Langford *et al.* (2000) used this approach in looking at perceptions of polluted coastal bathing water. They found significant associations with cultural worldview scores and responses to various questions about the risk and its management, which were in line with what would be expected from the theory. In addition Langford *et al.* held focus groups with each cultural type, recruited from those scoring highly on one particular worldview score. The focus groups showed that in a group context, people did indeed articulate patterns of beliefs and preferences as predicted by the theory. For instance, 'individualists' espoused market-based approaches to environmental regulation, whilst egalitarians were concerned about equity and accountability. The groups also shed some light on how people based their answers to some of the questionnaire, which was in part an economic contingent valuation, on quite different reasoning. However it is still hard for the empirical research to escape the accusation of tautology. Whilst concluding that the application of cultural theory in this way provided a useful tool for characterising and analysing responses to risks in a way which provides insights beyond the usual sociological classifications of age, class, gender and so on, the study could not be taken as a rigorous testing of the theory itself.

Despite these weaknesses, cultural theory made a strong and influential contribution to social theories of risk in theorising how risk and risk responses are shaped by processes of identity and social relations, and are embodied in institutional structures. Through its strongly social constructionist paradigm, it is able to articulate the insight that perceptions may not be something separate from the risk but rather constitute the risk itself - a point to which later discussions will return.

2.1.4 The social amplification of risk

In 1988, in the US, another group of decision researchers proposed what aimed to be an overarching framework for the social analysis of risk and risk perception, called the 'social amplification of risk' (Kasperson *et al.* 1988). This models how events related to natural or man-made hazards interact with psychological, social, cultural and institutional processes in ways that can amplify or attenuate perceptions of risk.

The model uses a metaphor from communication theory: the 'signal' originates in a risk object or situation and is processed through 'amplification systems', which may be individuals or social groups, and may include risk assessors, technical experts, the media, activist organisations and informal personal networks. These 'amplification stations' generate and transmit information by various channels and recipients will then further engage in amplification or attenuation processes. Amplifications will lead to secondary impacts such as enduring perceptions and images; impacts on local economies; political and social pressure; changes on monitoring and regulation of the risk; and repercussions on other technologies and institutions. Secondary impacts may themselves be amplified and lead to tertiary impacts, producing 'ripple effects' which disseminate social and political impacts, and widen the sphere of influence both geographically and temporally. 'Amplification' can trigger demands for additional institutional responses and protective action despite risks being seen as low by experts. However, 'attenuation' may also occur and relatively serious (by expert judgement) risks can receive comparatively little attention; naturally occurring radon gas is often used as an example of this.

The social amplification model was an attempt to integrate different frameworks. However, its weakness is that it is largely descriptive and does not provide any in-depth understanding of how processes occur or why amplification might take place more with some risks than others. Constrained by the sound amplification metaphor, it emphasises a one-way flow of information rather than allowing any feedbacks or networks. Despite its effort to integrate psychological and cultural approaches, the approach is much closer to a cognitive psychological tradition, and it is essentially naïvely realist about risk in that it implies a true baseline risk which is then amplified or attenuated by psychological and social processes. The authors claim that the amplification process is not separate from the risk (Kasperson 1992) but the model lacks sufficient analytical insight into cultural processes and indeed the significance of culture for this claim to be convincing.

Because of its very broad and general framework, the social amplification of risk model is difficult to test empirically and has tended to be applied descriptively or piecemeal. It has often been used with an emphasis on risk communication and trust (e.g. Breakwell 2000; Frewer, Miles and Marsh 2002) and in contrast with more cultural approaches, applications have essentially upheld the conceptual separation of a real 'out there' risk from the social responses to it (e.g. Leschine 2002; Williams *et al.* 1999). Such applications perhaps have not done justice to the original idea but the lack of insight into the role of culture has meant that this aspect has tended to be sidelined.

2.1.5 Beyond modernity: the sociology of risk, science and knowledge

There have been varied sociological works in the field of risk, but here I want to concentrate on recent influential commentaries about the nature and significance of risk in late modern society. In particular in this section I want to discuss work that has highlighted the relationships between expert and institutional knowledge, and lay knowledge.

The German sociologist Ulrich Beck, in *'Risk Society'* (1992), expounded a sociological analysis of the transformation of society from simple modernity into a new phase of later modernity that he terms 'risk society', by a process of 'reflexive modernisation'. 'Reflexive modernisation' is a condition of self-confrontation: society is a problem to itself. There are two elements: the reflex-like transition to risk society; and a growth of awareness and reflection as society becomes self-critical. In Beck's analysis, risk is one of the instigators of the transformation. Globalisation, individualisation, gender revolution, underemployment and global risks are all unforeseen consequences of modernity which act to undermine the stability of society, and society must respond to all of these simultaneously.

In pre-industrial society, risks were incalculable threats such as war, famine, magic, and demons. In industrial modernity, instruments of rational control were developed in order to calculate risk and manage it through systems of planning and insurance. In risk society, risks such as nuclear power, genetic engineering and ecological threat undermine the systems of simple modernity, as they cannot be limited in time and place, established rules of causality and blame do not apply, and they cannot be compensated for or insured against. Risk society, Beck argues, is therefore not an environmental problem but an institutional crisis. The instruments of modernity cannot cope: legal principles such as 'polluter pays' are inadequate, science is questioned, experts are dethroned. More than this, more and better knowledge is itself becoming the source of new risks, as for example with genetic advances.

Society has become individualised and decisions that used to be dealt with in social groups are now more and more the moral responsibility of individuals, while questions about how to act are no longer answerable by experts. As collective sources of meaning of the culture of industrial society disintegrate, the work of definition is imposed on individuals. Definitions of risk in reflexive modernity are therefore contested and mediated. Defining risk is political. This demands an opening up of the decision-making process, not only of the state, but also of corporations and science. A better-developed public sphere is needed, in which questions of value that underpin risk conflicts can be debated and judged. Risk is connected with trust, responsibility and security. Difficulties need to be resolved: what counts as sufficient proof of a threat (e.g. global warming) when knowledge about risks is contested and probabilistic? What are appropriate forms of damage limitation and regulation?

At about the same time that Beck published *Risk Society*, Giddens (1990; 1991) was writing along similar lines and expounding a theory of the progression of society into 'high modernity' which is diagnostically similar to that of Beck in many ways; certainly with respect to their treatment of the rise and significance of risk in late modernity they are often bracketed together.

According to Giddens, key aspects of the development into 'high modernity' are: increasing institutional reflexivity; the reorganisation of time and space; and the expansion of 'disembedding mechanisms' (such as information technology) which act to free social relations from specific locales, allowing them to be recombined across space and time distances. The future is 'colonised' by means of a reflexive organisation of knowledge environments – however as this cannot ever be complete, risk is fundamental. High modernity introduces new risk parameters including high consequence risks deriving from the globalisation of social systems - risks such as war, ecological disaster, collapse of global economic mechanisms, and the rise of totalitarian superstates.

Doubt is also a pervasive feature of high modernity, according to Giddens' view. Expertise is frequently internally contested and divergent in implications. Individuals must negotiate their choices among a diversity of options. Lay attitudes towards science, technology and expertise in high modernity thus express 'mixed attitudes of reverence and reserve, approval and disquiet, enthusiasm and antipathy' (1991:7). Trust, scepticism and rejection all come into play. The intrusion of abstract systems, particularly expertise, in day –to-day life is 'deskilling' of individuals; however individuals may 'reskill', which Giddens implies is a process of self education by amassing knowledge from different (expert) sources. Giddens sees this as potentially an empowering reappropriation of knowledge and control on the part of lay actors.

One of the major criticisms to be aimed at Beck in particular is that he overemphasises the extent to which the nature of risks and their distribution in society have changed (e.g. Draper 1993; Gandy 1997). Beck argues that "smog is democratic" (1992:36): that the new generation of risks affect rich and poor alike, crossing the sociological and geographical organising categorisations of modernity, such as class and place, and forming new risk communities along divisions of those who benefit and those who bear the risks. It is questionable how much this is actually the case; clearly with some new technological risks such as genetically modified food this argument may hold, but at the same time Beck's theory underplays the extent to which many hazards / risks (and smog may indeed be a good example) are unequally distributed both socially and spatially. The people who suffer most are those who have always suffered most. This last point is in fact the crux of the environmental justice movement – that the traditionally disempowered, particularly the poor and racial minorities, both suffer a greater share of many risks and lack the economic and political power either to make choices or to achieve protection or compensation. Giddens (1990; 1991), in expounding the nature of risk in high modernity in rather less detail, may be less culpable here, although his similar diagnosis that new global risks result from the re-organisation of social systems across time and space similarly implies a change in the traditional distributive characteristics. He does note that issues of class and inequality along sociological distinctions such as gender and race directly mesh with his arguments (1991 chapter 1), but this does not seem to be in terms of exposure to risks or the negative impacts of high modernity, so much as in access to forms of empowerment.

A second, related criticism is that both Beck and Giddens overplay the extent to which risks in later modernity are global in character, and more to the point, global in the way that they reside in the public consciousness (Bush *et al.* 2002). Just as this may ignore important social and spatial contexts relating to distribution, Bush *et al.* argue that the over-emphasis on the globalisation of risks and in particular on the role of 'disembedding mechanisms' in diminishing the importance of place, misses the extent to which local context is central to the experience of risks. This is an important argument which could be expanded as a theory of a geography of risk, although these authors are epidemiologists.

Other authors, in the air pollution literature in particular, make related points in theorising how local context is important in the experience of air pollution and in the formation of local knowledge about air pollution (see Bickerstaff and Walker 2001; Bush *et al.* 2001a; Howell *et al.* 2002, to be discussed later). Also important here are Irwin *et al.* (1999) who present research on the risk understandings of people living close to a chemical industry site in Jarrow, north east England, an area of high unemployment, social deprivation and crime rates. Irwin *et al.* conclude that local understandings are formed in the context of wider understandings of local life. Part of this relates to the local environment: "environmental hazards may be construed as reflecting and reinforcing a more general sense of the locality as being a faulty environment" - faulty here incorporating a range of social issues as well as the physical fabric. In such work, a geography of risk is emerging, linked with issues of the sociology of knowledge production to be discussed below.

The third major criticism of both Beck and Giddens relates to arguments about epistemology and the sociology of knowledge. Both Beck and Giddens have been taken to task for being too rationalist, and privileging scientific knowledge over other forms of knowledge (Szerszynski *et al.* 1996). This may be less true of Beck than Giddens: in *'Risk Society'*, Beck talks of the need for a demystification of science and a demonopolisation of knowledge claims, and echoes Habermas (e.g. Habermas 1987) in his calls for a better-developed public sphere in which normative and moral questions behind risk issues can be openly debated. Beck talks about moving forward by using a science reconnected to social practices and values. While Szerszynski *et al.* (1996) read this as a failure to depart sufficiently from the hegemonic instrumental rationality which they see as the root of the environmental crisis, others have read Beck both here and elsewhere (Beck 1995) as providing a useful attempt to find an epistemological middle ground between scientific and technical rationality, and cultural and symbolic consciousness (Gandy 1997).

Both Beck and Giddens see one of the symptoms of reflexive modernisation as being the greater burden placed on individuals to construct and negotiate truths and meanings for themselves in a world of competing and conflicting expert opinions. Wynne (1996) criticises this position for what he sees as a diminished view of lay knowledge. Lay knowledge is portrayed as 'epistemically vacuous', Wynne argues, having little intellectual content or instrumental value and having authority only in the sphere of values and subjectivity. He also objects to the inferred lack of intellectual agency on the part of non-experts: that the crisis is only seen as being brought about by the increasing public disagreement between experts and their failure to protect the lay public from risks, and in the case of Giddens at least, that the task of lay people is then merely to choose which experts to trust.

These three criticisms mirror three central theoretical threads of this thesis: environmental equity and the distribution of hazard and risk; the role of local context in shaping the experience and understanding of risk; and lay knowledge and its relationship with expertise. The first theme, environmental equity, has a distinct literature which I will discuss in section 2.2. The second theme is less distinct as a theory of risk, but context has had very relevant treatment in the field of health geography, which I discuss in section 2.3. Arguments about the role of context also start to appear in the air pollution literature discussed in section 2.5.2, where they are often integrally tied in with theories regarding lay knowledge and expertise. Indeed it is the integration of ideas of place-based local experience with those of lay knowledge that underpins a concept of 'local knowledge'. In this sense, the second and third themes are very much related. The third theme, that of lay knowledge and its relationship with expertise regarding environmental/health risk issues, has relevant strands from both the environmental risk/public understanding of science literature, and from the social studies of health literature, which I discuss in sections 2.4.1 and 2.3.2.

2.2 ENVIRONMENTAL EQUITY AND AIR POLLUTION

Concern over distributional equity in relation to environmental and health risks has been the basis of what has become known as the concept of environmental equity. Cutter (1995:112) defines environmental equity as "a broad term that is used to describe the disproportionate effects of environmental degradation on people and places".

Environmental equity is allied to environmental justice and to some commentators the terms are synonymous (e.g. Harding and Holdren 1993). Environmental justice has its roots in a 1970s US civil rights movement, which was concerned with discrimination in environmental policy-making, particularly in the siting of toxic facilities. The early movement was more specifically concerned with racial discrimination and was also termed 'environmental racism', as a growing body of studies showed that racial minorities suffered a greater burden of environmental hazards and risks (e.g. Bullard 1983; United Church of Christ Commission on Racial Justice 1987). However, throughout the 1980s and 90s this concern broadened to encompass risks imposed on any disadvantaged or under-represented groups including non-white communities, children and the poor.

Coming from this background of political and community activism, environmental justice is a more politically charged term than environmental equity. To some, while equity implies an equal sharing of risk burdens (e.g. Lavelle 1994), environmental justice champions political and sometimes legal action to reduce overall risk and in particular to correct any injustice to any particular group (Cutter 1995). In the US this has been successful to the point that environmental justice is now mandated by presidential order to be part of environmental and public health policy assessment.

For the purpose of this thesis, I have used the term 'environmental equity' as a conceptual framework to allow consideration of the distributional aspects of the hazard and risk in question, including the experience of the hazard, but clearly there is much relevant work that has used the term environmental justice and I will also discuss relevant such studies in this section.

Given its origins in the US, to date most of the research work concerned with environmental equity / justice issues has come from the US. Exposure to air pollution specifically and its attendant health risks has been the concern of a substantial subset of environmental equity / justice research particularly in more recent years.

US Studies have looked at relationships between air quality and both poverty/class and race. The results with respect to race clearly suggest that minority communities suffer a greater proportion of the toxic air pollution burden, a relationship which is separate from any other effect of income or deprivation (Sadd *et al.* 1999; Morello-Frosch *et al.* 2002; Lopez 2002; Pastor, Sadd and Morello-Frosch 2002; Perlin Wong and Sexton 2001).

The relationships between air pollution and poverty have been more equivocal however. Some research found that poorer people were more exposed to air pollution (e.g. Freeman 1972, cited in Brown 1995; Glickman *et al.* 1994 cited in Perlin *et al.* 1995; Jerret *et al.* (2001) in Ontario, Canada. Other studies have not found this. In an early study, Gianessi *et al.* (1979 cited in Brown 1995) looking at the whole US found upper income people facing higher exposure than lower income. Gelobter (1992 cited in Brown 1995) found clear race differences in particulate exposure but a smaller class difference, with the highest income group sometimes having the highest exposure. Perlin *et al.* (1995), aggregating emission and population data at county level, found that members of several non-white ethnic groups were more likely to live in a county of higher toxic air releases, but that counties of higher toxic emissions tended to have higher than average annual household income. Similarly Daniels and Friedman (1999) found that the highest level of releases occurred in middle income counties. Jerrett *et al.* (1999) also found a positive relationship between household income and pollution emissions in the counties of Ontario, Canada.

There are methodological issues in environmental equity studies, which may account for some of these results. In particular, the scale of analysis may have a large effect on the observed relationships, as some studies have shown (Tiefenbacher and Hagelman 1999; Glickman *et al.* 1994 cited in Perlin *et al.* 1995). Perlin *et al.* (1995) account for their result with respect to poverty by the fact that the data was aggregated at county level and that urban counties contain more pollution emitting facilities, a higher proportion of ethnic populations, and more higher income households. Similarly Brown (1995) explains the results of Gelobter (1992) and Gianessi *et al.* (1979) by this urban effect.

Not only the scale of analysis, but also the choice of statistical testing or modelling procedure can affect results (Perlin *et al.* 1995). As an example, Jerret *et al.*'s (2001) Canadian study showed that low income and unemployment were significant predictors of exposure to particulate pollution, but results varied depending on the method of analysis, with relatively minor changes in statistical models resulting in changes in the significant predictors.

Most of the US environmental equity studies on air pollution have been concerned with industrial pollution. Few have focused on traffic emissions, but those that have, have again shown inequity in distribution (Gunier *et al.* 2003 with respect to income; Morello-Frosch *et al.* 2001 with respect to race).

The US has taken the lead in environmental justice / equity studies of air pollution due both to the rise of the environmental justice movement in that country and also to their longer established legislation on air quality (Brainard *et al.* 2002). Only relatively recently have similar studies been published in the UK. Interest has been stimulated largely by the development of the UK National Air Quality Strategy. One of the first of its kind was McLeod *et al.* (2000), investigating the relationship between social class and 3 air pollutants – SO2, NO2 and PM10 – in England and Wales. Local authority districts were the smallest unit of analysis. They found that overall there was a negative relationship between all three pollutants and social class, i.e. concentrations of all three pollutants were higher in lower class districts. All 3 pollutants were also positively associated with being non-white, an effect which still held when social class was controlled for. However, when population density was accounted for – which would account for urban vs. rural effects – the effect of social class was reversed, i.e. higher social class was associated with higher pollution. They offer the explanation that in some areas of similar density, probably urban areas, relatively expensive housing may be found near the centre where pollution would also be highest.

It should be noted that McLeod *et al.* (2000) used social class as a variable rather than a measure of deprivation or poverty and this has implications for comparison with other

UK studies, as the occupational social class index may not be a good proxy for actual socio-economic conditions (King and Stedman 2000). Clearly the issue of scale is still a factor, as local authority districts are large and it is possible that relationships at this level may not hold true at a smaller level, as some US studies have implied (see above).

In UK government sponsored research, King and Stedman (2000) compared maps of air quality (mainly background emissions) with deprivation indices for Greater London, Birmingham, Glasgow, Belfast and Port Talbot. They concluded that there was some evidence for a positive correlation between background NO2 and PM10 concentrations and deprivation in London, Birmingham and Belfast, and between roadside NO2 and deprivation in London, but that in Glasgow the relationship was inverse, i.e. air pollution decreased as deprivation increased. The latter was also true for PM10 only in Port Talbot. The results held whether the scale of analysis was ward or enumeration district. However, no patterning was found when social class rather than social deprivation was compared with air quality, which is interesting in the light of McLeod *et al.*'s (2000) study.

Following on from this report, Pye *et al.* (2001) performed an analysis of NO2 and PM10 concentration and deprivation for London, Birmingham, Cardiff and Belfast. In this report they concluded that London, Birmingham and Belfast showed a positive correlation between deprivation levels and both NO2 and PM10, but that Cardiff showed no relationship. Again this was little affected by the scale of analysis. They then looked further at the different domains from which the deprivation indices were composed and found that the positive correlation held true for most of them. However access to services had the inverse relationship in all areas – i.e. better access was associated with increasing pollution. This is not surprising as traffic emissions would be highest on main roads and it lends some weight to the argument of McLeod *et al.* (2000), that the mechanism of people choosing to live in areas with good access to amenities may act to expose better-off people to higher pollution.

The two above reports conclude that pollution reduction measures, if targeted at the most polluted areas, could have greater benefits for deprived communities, and thus reduce environmental inequity. These are government sponsored pieces of research and show the UK government paying attention to environmental equity concerns. However it is notable that the UK version has stuck with the less politically charged 'environmental equity' approach rather than the environmental justice conceptualisation in US environmental policy.

Recently, Brainard *et al.* (2002) expanded the traditional categories of race and poverty in looking at environmental equity, and compared modelled emission levels of NO2 and CO with age profile, ethnicity and poverty indicators at the level of enumeration district in Birmingham. They were interested in young children and in pensioners as vulnerable populations, but found no statistically significant indication that these groups suffered greater exposure. In terms of ethnicity, they found that white populations experienced the lowest level of emissions, followed by (in ascending order), Indian, Pakistani, black and Bangladeshi populations. With respect to poverty, Brainard *et al.* found a clear trend to higher emissions with increasing deprivation, based on comparing quartiles. For instance the most deprived 25% experienced on average 1.3 times the NO2 exposure and 1.5 times the CO exposure of the least deprived 25%. They also concluded that the effects of poverty and ethnicity appeared to be independent.

Mitchell and Dorling's (2003) study adds another dimension to the environmental equity / justice inquiry: they compared the distribution of NO2 in all wards in England, Scotland and Wales with a measure of poverty, with age profiles and also with car ownership. They pursue the question, not only do poorer and / or more vulnerable people suffer a greater amount of pollution, but is more pollution suffered by people who contribute least to it? With respect to age, children from 0-9 years and adults from 20-34 tended to be resident in the more polluted wards, whilst the elderly, another vulnerable group, tended to live in the least polluted areas. The relationship between NO2 and poverty was not a simple linear function: Mitchell and Dorling found the poorest wards tended to experience the worst air quality, but the least poor did not experience the best. The question surrounding who pollutes / who suffers had interesting results: there was a linear negative relationship between NO2 and car ownership, i.e. non- drivers were more likely to experience higher residential NO_2 – although this does not equate to a relationship with poverty, as some of the low car ownership wards would be relatively wealthy, such as parts of inner London. Also, wards with more multiple car ownership (3 or more) households tended to be the less polluted. However, car ownership is not necessarily a proxy for pollution, as older cars pollute more, and indeed there was no observable relationship when plotting modelled emissions against poverty, implying that the poor, though they probably suffer more pollution, do contribute a significant proportion of it. Still, in a final analysis plotting emissions and air quality simultaneously against poverty, they concluded that there was a group of wards that emit the least NO_x but have the greatest NO_2 concentrations and are clearly the most deprived. Thus they concluded that there is clear evidence of environmental inequity.

What these UK studies introduce in comparison to most of the US studies is some different dimensions to the equity / justice concept. The body of US studies have generally assumed (with justifiable reason) that inequity or injustice occurs when poorer or minority populations are exposed to a greater burden, as these are relatively disenfranchised people who have less input into the decision making process. Most of the studies cover only these categories. Whether there can be said to be an injustice, or an inequity that should be rectified, if better-off or non-minority people suffer more pollution is not addressed in these US studies.

Brainard *et al.*'s (2002) study expands on most of the US studies by including in the analysis children and the elderly as particularly vulnerable groups of interest in the environmental equity debate. McLeod *et al.*'s study introduces the concept of choice. If people are suffering more pollution by (default) choice, because they value other aspects of where they live, then the implication is that there is no injustice. The assumption is that better-off people can make the choice whilst poorer people are more limited, which is perhaps implied in the conceptualisation of most earlier studies but addressed more explicitly here. Mitchell and Dorling (2003) put the question of equity or justice in terms of how much people suffer compared to how much they pollute. This raises a conceptual issue about justice – should everyone suffer the same, or should they suffer in proportion to what they produce? Mitchell and Dorling's study does not just assume that poorer people contribute less pollution but examines this question empirically. And, if it was richer people who suffered more pollution than they contributed, would that be an injustice, or would that inequity be mitigated by their greater ability to move? Such questions render the debate a little more complex than the earlier conceptualisations, and point to a need for a more explicit setting out of assumptions and consideration of what a just or equitable situation might be.

There are other possible dimensions to environmental justice / equity. Cutter's (1995) definition at the beginning of this section actually uses the term 'disproportionate effects' and a facet of this, which a few studies touch on but most do not, is that at the same level of pollution, some people are more vulnerable to the effects than others. The studies which address vulnerable age groups do take this on board to some extent. This again is a somewhat different take on justice. The environmental justice movement was concerned with social justice and the effects of unequal power relations being played out in the distribution of environmental hazards and risks. However bringing the concept of medically vulnerable groups such as the young and old or those with asthma into the equation could be seen as something different.

These concepts can however connected. Some studies, e.g. Brainard *et al.* (2002) do not make a particular connection between medical vulnerability and social / economic vulnerability, seeing them as separate categories of vulnerability, but other commentators point out that these often compound each other, and thus use medical vulnerability to give added weight to the social justice / power argument. Perlin Wong and Sexton (2001) for instance highlight that Afro-American families who suffer more pollution are also more likely to have young children. Samet *et al.* (2001) point out that conditions such as asthma are more prevalent in low-income communities and there is evidence that the increased prevalence may be quantifiably related to the level of deprivation (Duran-Tauleria and Rona 1999, cited in Samet *et al.* 2001). To pursue this line of argument, research has shown that individuals in more deprived communities are also more likely to smoke (Kleinschmidt *et al.* 1995) and to have a poorer diet with less antioxidants (Nelson

2000), both of which will compound any effects of pollution. Thus equitable distribution of pollution does not necessarily equal equitable effects.

In addition, distribution does not equal dose. It is an assumption inherent in the spatial modelling studies reviewed that injustice or inequity in risk burden can be assumed from inequity in spatial distribution. Thus, studies have used either emissions or concentrations as a proxy for measuring the risk suffered by any given community. This assumption is recognised and well discussed in much of the literature (see Perlin *et al.* 1995, Jerret *et al.* 2001, Mitchell and Dorling 2003 for example). Furthermore, most assume that residential exposure is an indication of actual exposure. This becomes less important the larger the unit of analysis, as people are likely to live, shop, socialise and work in the same US county for instance, but it is more important when looking at enumeration district level relationships for example, as did King and Stedman (2000) and Brainard *et al.* (2002). Also, people's personal dose will depend a lot on other factors such as how often they leave the house, where they walk, whether they drive and so on.

To recap, spatial studies that map pollutant levels against socio-economic variables have contributed valuable insights into how the distribution of the attendant health risks might vary across populations. In terms of environmental equity and justice, these studies have been very valuable in understanding how social injustices may be perpetuated, or how more vulnerable, less powerful or less polluting people may suffer a disproportionate amount of the burden. However, there are certain weaknesses and partialities in the domination of this approach.

i) The results of such studies have been shown to be to some extent dependent on the methodology, including the scale of measurement and the choice of statistical analytical approach. Inconsistencies between studies in approaches used have led to equivocal results.
ii) Different pollutants have been measured and in different ways: some using concentrations, some using emissions.
iii) Concentration / emission has been assumed to be some indication of average dose or risk suffered.

iv) The choice of socio-economic variables of interest differs, as well as their scale of measurement – for example to examine material socio-economic disadvantage, studies variously use deprivation indices (which vary), income, social class, unemployment, or a combination of these.

In addition to these characteristics of the specific research approach, there are other issues about what may constitute environmental justice or equity, which are not always explicit. Having grown out of a civil rights movement, environmental justice was originally conceptualised as protecting the interests of the less powerful, generally in practice held to be non-white racial groups and the poor. Inequity or injustice however could also be seen to be tied up with issues of choice, particular vulnerability to the effects of pollution, and questions of who causes the pollution, which may well follow similar socio-demographic groupings but which sometimes may not. For instance, young children of all racial and income categories are more vulnerable to the effects of pollution; wealthy people in large cities may choose not to drive cars and so not be great contributors to pollution levels.

It is here that social and geographical context is important. The concept of environmental equity makes social context central to risk issues, in arguing for fairer distribution. However spatial studies in fact reduce social context to aggregate variables; they also, in focusing on quantitative distribution as the issue, tend to imply that equal concentration = equal dose = equal burden. Some studies have raised the issue of how social context may affect the burden suffered at any given level, in terms of lack of choice or increased medical vulnerability, but on the whole this has been underdone. Geographical context, in terms of how this may influence the burden, has been even less well addressed. This imbalance, which is in a major part due to the dominance of spatially-based, quantitative studies, needs to be redressed by work focusing on the experiential aspects of hazard and risk burden. Such work can give insights into how hazards and their attendant risks are experienced in context and how inequities may or may not be played out at this level.

2.3 HEALTH GEOGRAPHY AND THE TREATMENT OF CONTEXT

At this point I would like to turn to the subdiscipline of health geography. Health geography has given much more focused treatment to the issue of geographical context, the ways in which it can be conceptualised and how context may affect health and wellbeing. Although traditionally medical geography was more concerned with the determinants of medical outcomes, such as the prevalence of disease, the idea of risk is still central to this, given its population perspective. The more cultural turn in the field which led to its being widely renamed as 'health geography' (Kearns and Moon 2002) brought a broadening of agendas and theoretical scope to address issues of wider wellbeing, more holistic and constructed concepts of health, and the importance of the experience of place to these. Thus this development has brought health geography agendas into clearer overlap with the simultaneously broadening study of environmental hazard and risk, and there are important lessons to be learned about how a geography of the experience of risk might be theorised.

Health geography has argued that the characteristics of places as well as the characteristics of the people that inhabit them are important in determining the health of the population. These have respectively been termed 'contextual' and 'compositional' effects, and separation of these has often been the focus of conceptual and methodological concern. The development of multi-level modelling techniques (see e.g. Goldstein 1995) has been particularly important in showing that area-level characteristics may be quantitatively related to health outcomes, even whilst accounting for variations in the individual characteristics of the population that make up the population of that area (e.g. Leyland and Goldstein 2001; Duncan and Jones 1995; Langford and Bentham 1996). Such studies can be limited to being descriptive of relationships in datasets; however more theoretical work and work with a variety of techniques and approaches has been concerned with understanding the processes by which the contextual effects of place may operate.

Curtis (2004:22-23) explains that the concept of 'landscape' may be useful in conveying the idea of 'a system of factors and processes that interact in particular settings to produce geographical variation'. This system approach importantly allows for the inclusion of physical and social processes, and their interaction. Crucially, Curtis states that different conceptual landscapes associated with different theoretical approaches may be seen as overlaying each other in the same place. Curtis and Jones (1998) enumerate 5 possible 'landscape' perspectives, based on different theoretical approaches. These are:

1) Ecological landscapes (framed by ecological / epidemiological theories)
2) Materialist landscapes (framed by, for example, structuration theory)
3) Landscapes of consumption (framed by for example Bordieu's (1990) concept of 'habitus')
4) Landscapes of social control [Curtis 2004 adds the possibility of resistance here] (framed by theories of surveillance and territoriality)
5) Therapeutic landscapes (framed by humanist theories of sense of place).

There are numerous literatures within each of these approaches which it is not possible to review here. However some of these concepts of landscape are potentially particularly useful to apply to the investigation of experiences of air pollution in context. It is also important to note that the conceptual separation of compositional and contextual effects is a useful demarcation in analysing the factors that potentially affect peoples perceptions, constructions and experience of an environmental risk.

The ecological landscape perspective relates clearly to the conceptualisation of geographical context as important in terms of geographical variation in exposure to environmental conditions, such as climate, pathogens and pollution. Here, place is conceptualised as physical space. The ecological approach characterises the fields of disease ecology and environmental epidemiology. The approach of environmental justice / equity, as discussed above, is also an ecological approach, in that it maps spatial variation in exposure to environmental hazards, although unlike environmental epidemiology it does not relate this to measured health outcomes, but rather is concerned with the ethics of this variation and the implied variation in levels of risk. Ecological approaches tend to be positivist and quantitative (see Gattrell 2002 for an explanation of positivist approaches to health geography).

Materialist landscape conceptualisations, whether or not informed by structuration theory, could be concerned with whether and how for example differences in area characteristics such as housing and provision of amenities might affect people's perception and experience of environmental risk / hazard. Such an approach is essentially realist (in the sense of Sayer 1984 and Bhaskar 1986) although not necessarily positivist. This approach is also relevant to environmental equity in that it may focus on socio-economic inequalities in health, and by implication, risk, at both individual and area level.

The specific concept of the 'therapeutic landscape' (see Gesler 1992; 1993; Kearns and Gesler 1998; Williams 1999) is concerned with how a sense of a place may contribute to (or detract from) health and wellbeing. This is a humanistic, constructionist approach and utilises a broader conceptualisation of health to include aspects of mental state, recognising that physical and psychological health may not be entirely separable. This approach holds that cultural factors affect the way that people interpret and respond to the physical and material dimensions of their surroundings (whether natural or man-made landscape) such as air quality and building design. The importance of the symbolic properties of places is also highlighted.

The concept of the therapeutic landscape has tended to be applied to analysis of specific places – often, although not always, places with a reputation for healing – including for example Epidaurus (Gesler 1993) and Lourdes (Gesler 1996), and has also been used in investigations of the health promoting potential of the design of treatment settings (e.g. Hubbard et al 2003). Wilson (2003) however argues that there is a need for more emphasis on everyday geographies as an integral part of people's identities and health – in the case of her research, that of First Nations people. More recently, Milligan *et al* (2004) applied the concept to allotments, arguably an everyday place in the life of a group of older people in northern England.

The therapeutic landscape thus offers a way of conceptualising how geographical context in terms of the sense of a place and its attributes may be related to people's understandings and sense of their own health and wellbeing.

These explorations and explications of the role of context in understanding health therefore provide potentially useful frameworks for understanding environmental hazard and risk in context. Of particular interest is the recognition by some health geographers that geographical context acts as a system, and that different theoretical interpretations may be overlain in understanding the different elements of this system.

2.4 LAY KNOWLEDGE AND EXPERTISE IN ENVIRONMENTAL AND PUBLIC HEALTH RISKS

I noted in section 2.1.5 that Beck's and Giddens' theories of the relationship between expert and lay systems of knowledge in late modernity have been criticised for privileging scientific rationality and for portraying the public as lacking in epistemically valid knowledge. In this section I will discuss and critique how writers in environmental risk and the public understanding of science have conceptualised lay and expert knowledge and the significance of disjunctures between them. I will then go on to discuss how similar issues have been raised in the literature relating to health, and in particular public health and epidemiology.

2.4.1 Lay knowledge, risk and the public understanding of science

The perspective of Szerszynski *et al.* (1996) and Wynne (1989; 1992a; 1992b; 1996) draws on the field of the sociology of scientific knowledge (SSK) and on perspectives which emphasise the co-construction of nature and culture. These authors see the root of environmental (risk) problems as being in realist, positivist science and rational choice social science models. Both models, they argue, are culturally disembedded and fail to recognise the culturally rooted, social relational dimensions of risk and environmental issues – a social constructionist point of view which has echoes of Douglas's (1985) cultural theory discussed above.

Work on the sociology of scientific knowledge sees science as rooted in traditions and local practices, such as laboratory practices (e.g. Kuhn 1962; Latour and Woolgar 1989; Latour 1983; Knorr-Cetina 1999). According to this perspective, science, like any other knowledge system, unavoidably embodies assumptions about the human and the social, and makes commitments to particular epistemic and cultural principles. A more 'symmetrical analysis' of science and other forms of (local) knowledge allows such interests to become clear (Latour 1992) and also makes room for other forms of lay knowledge to be taken more seriously.

Wynne (1989, 1992a, 1992b, 1996) argues strongly that non-experts may hold forms of knowledge which are not merely in the realm of the moral and subjective, but which are intellectually strong, although they may be in conflict with the epistemic and therefore cultural / political commitments of science. He develops his argument with reference to two case studies in particular.

The first is a study of Cumbrian Sheep farmers during the aftermath of the Chernobyl nuclear accident in 1985, when meat from sheep grazing in the Cumbrian uplands became contaminated with radioactivity and could not be eaten. Scientists' estimates of how long it would take for the radioactivity to subside to safe levels in the vegetation and so in the sheep were seriously wrong, a situation which had severe economic repercussions on the farmers. According to Wynne's (1996) analysis, much of the problem lay in the need for science and the scientists to be able to predict and control through a system of universalising models. Such models were unable to adapt to local contexts and variations in practices and conditions from farm to farm. The local farmers themselves, on the other hand, were familiar with local variations and their knowledge was adaptable to variations and changes. Science, however, denigrates such local knowledge, and its potential value in helping the situation was lost. The analysis goes beyond the single situation in illustrating a sociological principle: science worked on a particular model of the physical, but also upheld social principles of regulation and control, principles which were aligned with the political and bureaucratic system by which the farmers' situation was handled in terms of regulation and compensation. In contrast, the farmers' knowledge and social relations were linked by their comfortableness with variability and contextuality.

The second case study is of the use of the herbicide 2,4,5-T in the UK (Wynne 1989). Labour unions' claims of health damage to agricultural workers from the use of this herbicide were dismissed by the scientific Pesticides Advisory Committee. This turned out to be erroneous because it was based on the assumption that conditions of use in the real world would be the same as in the laboratory – an assumption which would have been almost impossible to uphold. The workers' knowledge of their real conditions however was not considered.

The important points that Wynne uses these case studies to illustrate are

i) that both science and lay knowledge are conditional;
ii) that both may contain knowledge which is of instrumental use;
iii) from the analysis of the Cumbrian sheep farmers case, that knowledge systems are co-constitutive of systems of social relations.

This latter point is not new from Wynne but is founded on work from SSK writers such as those cited above. However Wynne develops this point in much of his work with a specific emphasis on risk. Science, and scientific framings of risk, he argues, impose a particular model of the social and human on the public, a model which, to return to Szerszynski *et al.* (1996) above, is objectivist and disembedded from social relations. Wynne sees this in very strong terms as alienating and "morally-emotionally threatening" (1996:60). This threat intensifies, and becomes part of, the risk. The social anxiety which is engendered by this alienation tends to be misinterpreted as ignorance or irrationality whereas in fact it is a manifestation of the threat to people's social identities (Wynne 1992a; 1992b; also e.g. Michael 1996).

The second major thrust of Wynne's work therefore, integrally connected to his points about conditional knowledges, is that risk issues are primarily social relational, where trust and social identity are central concerns. People are dependent on expert systems and institutions but where trust is lacking, conflicts may occur which can manifest as public unacceptance of a risk. The trustworthiness of controlling institutions is therefore a crucial factor in both risk perceptions and the objective scale of the risk, as it will cause repercussions (this has echoes of the social amplification model discussed earlier). This is a point of departure from Giddens: Wynne sees public relations with expertise as having always been reflexive, ambivalent and sceptical, rather than this ambivalence being a new phenomenon brought on by public disagreement between experts in a new phase of modernity.

Wynne's argument is essentially rooted in epistemology and in an exposure of the social relations and political interests upheld by knowledge systems. Thus an imposition of scientific knowledge can result in social alienation, mistrust and threats to social identity which may manifest as public unwillingness to accept risks.

With the emphasis on social identity and the connection of knowledge with social and moral interests, Wynne's work is in many ways close to that of Douglas (1970; 1985) and cultural theory, although less deterministic and without the rigid typology of social groups. Both take a relatively strongly social constructionist perspective on risk.

Wynne's work represents perhaps the most developed and coherent body advancing this argument in the field of environmental risk, but similar arguments have been made by others in the field of public understanding of science (see e.g. Layton *et al.* 1993 cited in Irwin 1995; Irwin 1995; Irwin *et al.* 1996 and Michael 1996). These authors argue against a simple 'deficit' model in the public understanding of science – i.e. the model that the public lack scientific knowledge and need to be given it in order to rationalise risks.

Layton *et al.* (1993 cited in Irwin 1995) examine 4 case studies of expert-lay knowledge relationships. From these case studies they draw some general conclusions:

- the boundaries of science are problematic
- science is usually seen by laypeople as inseparable from social and institutional concerns
- ignorance may be functional and defensible and may represent a robust understanding rather than an absence of knowledge
- contextual knowledges are put together piecemeal and opportunistically by 'learning through doing'.
- 'everyday thinking' is more complex and less understood than scientific thinking.

These conclusions have been reinforced in more recent empirical studies, for example Irwin *et al.* (1996), studying communities living close to hazardous industry in north-west England, found that citizens discriminated between different (scientific) knowledge sources according to the perceived credibility of the source. Such information was weighed against a local knowledge consisting of previous experience and cultural evaluations, the attitudes of friends and neighbours, and knowledge of the production processes. Residents did have a concept of 'pure' science which was worthy, but 'out there' and contrasting sharply with locally provided information linked to a particular source. They also argue that such local knowledge will "view hazard and information issues as one part of a larger set of concerns about the area and everyday life" (1996:55). In this way, science could almost seem to 'disappear' in local discussions of the hazard, but rather than this being from ignorance, the authors see this as due to scientific information being evaluated on its (social relational) dissemination context, and then fitted in with existing knowledges and understandings.

Michael (1996) makes the point that people do not simply look at science as facts, but also reflect on the epistemological status of the knowledge: reflection that can directly affect their responses to experts and expertise. Identity is again therefore key. In looking particularly at discourses of ignorance, Michael argues that as well as unproblematised absence of information, such discourses play a variety of roles in the construction of a social relationship to science. Usefully, he distinguishes between 3 strategies of ignorance. Ignorance as 'non-scientific mind' articulates a subservient relationship to science; ignorance as 'not my job' a co-existence; and ignorance as 'not interested / not relevant' may be a positive choice as a moral or political challenge to science.

To summarise, according to these SSK perspectives, lay people see science and scientific information in any given situation in the light of the social and institutional context of its source. Lay people hold their own knowledges which are contextual rather than universalising, and formed from experience. Apparent ignorance may be functional rather than represent a deficit of knowledge or understanding.

Such examinations of expert vs. lay knowledges can imply that they are seen as separate entities, in opposition, and this perhaps is a weakness in the body of work as a whole. Some authors though have been at pains to point out that this perceived dichotomy is unhelpful, and that the point is one of identifying tensions between lay and expert ways of knowing, but at the same time acknowledging that lay knowledge may incorporate elements of science (Irwin 1995; Irwin, Simmons and Walker 1999) and also that there are many cases where expert and lay knowledges are not in conflict (Wynne 1992b).

Sociological perspectives on science-society relations in the arena of risk and the environment have thus offered a major challenge to the unquestioning primacy given to scientific knowledge in such situations. These perspectives however differ somewhat in the depth of the epistemological challenge: while some theorists such as Wynne and Michael see epistemology, linked with social relations and identity, as the central issue, to others such as Beck the epistemological integrity of science and the separation of nature and culture is less questioned, but the incorporation of social values into risk decision making in an age of uncertain science is advocated.

From such perspectives has grown an important body of work on how science may be opened up to public input and debates; influential examples include Funtowicz and Ravetz (1992), Wynne (1992) and Shrader-Freshette (1992). However, it is not within the scope of this thesis to go on to explore the large literature on public participation in decision-making relating to risk, environmental and science issues; see Petts and Leach (2000) and IEMA (2000) for recent reviews.

2.4.2 Lay knowledge and health

Parallel to social studies of risk, social science studies of medicine and health have developed a critique of medical knowledge and medical institutions, with roots in social constructionist theories and in the sociology of science. Such approaches have emphasised medical knowledge as contextual both historically and socially, rather than value free, neutral and necessarily in the interests of the population. This has led to critical examination of the relationship between institutionalised knowledge and the 'lay' public. As with the risk literature, the arguments in the social science and medicine literature have led to an interest in 'lay theories' and 'lay knowledges', accompanied by a turn to qualitative methods and interpretative epistemologies and analyses.

The critical social science and medicine literature comes from a number of perspectives, from structural to phenomenological. For example, one particularly critical perspective is the 'medicalisation' thesis, which refers to the phenomenon by which various problems and states of everyday life (such as childbirth, smoking) have become defined as medical, and thus taken under the jurisdiction of medical institutions – a form of medical imperialism. Different analyses have variously attributed medicalisation to: professional expansionism for the self-interest of medics (Freidson, 1970; Illich, 1976), acting in the interests of capitalism and its ideology (Navarro, 1975); or a Foucauldian manifestation of the exercise of social control (Conrad and Schneider, 1985). Feminist critiques have in a similar way examined how women's bodies and experiences have become defined and controlled by a patriarchal medical system, particularly in the realm of childbirth and reproductive technologies (Oakley 1980; Tew 1990).

Such structuralist approaches have been criticised for implying a passive population with few choices and little agency. More recently, theorists have been interested in how lay people may be viewed in a more active light and in how they may challenge the dominant institutions of medicine, through for instance self-help groups (Kelleher 1994) or opting into non-conventional medicine (Sharma 1992). Concepts such as reflexive modernisation from Beck and Giddens are drawn on to understand how lay people use various sources of information and knowledge to understand and make choices rather than being purely controlled by medicalisation processes (Williams and Calnan 1996a).

Perhaps a greater body of empirical work has come from a more phenomenological or symbolic interactionist approach within sociology and anthropology, in the field of health. Still taking epistemologically a social constructionist stance, such studies have concentrated on the individual's experience, and the meanings attached to their experience. One of the most influential of these was Kleinman's work, 'The Illness Narratives' (1988) which used depth interviews to explore the experience of chronic illness among American patients. Other well known work in this tradition in the UK includes Cornwell (1984) on the significance of health and illness within the lives of working class people in London, Donovan (1986) on ethnic groups' interpretations of health and illness, and Blaxter (1983) on lay people's theories on the causation of their illness. Blaxter (1985, 1990) argues that the idea of distinguishing a biological bedrock of illness from its cultural enactment is flawed and cannot be put into practice; much as critical theories of risk argue that the scientific or physical risk cannot be dissociated from its social context (e.g. Douglas and Wildavsky 1982; Wynne 1992; Szerszynski *et al.* 1996). Phenomenological work has often been criticised for failing to place experience within the political and economic context but this may be unfair. Interpretative studies have often been used in conjunction with more structural theories of class, race and gender as in the work of Cornwell (1984) and Donovan (1986) although the emphasis has tended to be experiential.

This approach, with its emphasis on the experiential, has been influential in health services research. Early studies of patient satisfaction tended to be by survey, and the majority tended to show that people were satisfied with the services provided (Williams and Calnan 1996b). However, concerns arose over the contextual effects of questionnaires, the superficiality and socially acceptable nature of the replies given in such studies, and in the imposed framing of concepts such as satisfaction (e.g. Fitzpatrick and Hopkins 1983). Qualitative, patient experience centred studies have therefore been applied to areas such as patients' views of their prescription drug regime (Britten 1994; Gabe and Bury 1996; Adams *et al.* 1997). Again, it is difficult to separate out structural / phenomenological strands completely, as studies of experiences of health services may be informed by for example feminist theories, e.g. in studies of reproductive technology (Denny 1994).

Thus, the growing interest in lay knowledges within the medical and health literature is informed by a number of perspectives. There is a spectrum from the more science-centred to the most critical view. Methodologically, the turn to ethnographic and qualitative approaches in order to research and understand lay accounts has been both in order to be able to capture fully the complexities of lay accounts, and more politically to allow a greater validation of people's own accounts in their own words and to avoid the imposition of expert framings and impersonal decontextualised models.

2.4.3 'Lay epidemiology' and lay knowledge in public health

Epidemiology and public health can be viewed as a sub-disciplines within the wider field of biomedicine, and as such, an interest in lay epidemiology could be expected to develop with, and from, the rise of interest in lay experience and knowledge within the social science and medicine literature. However, the medical interest in lay knowledge has tended to concentrate on the layperson's experience of illness, or of undergoing treatment. Lay epidemiology has not emerged as a particularly unified concept, and inasmuch as it does exist, is as much explored within the risk literature as the health literature.

As with studies of lay knowledge and health, one branch of interest in 'lay epidemiology' has come from within the medical or health professions, and takes a non-critical stance, being interested in understanding lay perspectives for the ultimate goal of improved compliance with medical regimes (e.g. Emslie *et al.* 2001; Ruston and Clayton 2002).

Popay and Williams (1994; 1996; undated) are two prominent writers in the more critical area of lay knowledge in public health research. They argue that since its 19th century roots in social reform, public health has become 'medicalised' and the voices of the community and their needs excluded. However, modern public health problems pose a challenge to classical epidemiology and require a re-thinking of the nature of the connection between social and biological dimensions of public health.

Williams and Popay (1994; undated) emphasise the ambiguous relationship between lay people and the world of expertise, and see the challenge of lay knowledges as two-fold: firstly epistemological, i.e. a challenge to science's claims of objectivity and truth; and secondly as a political challenge to institutional power and the authority of experts to determine how problems are defined in the policy arena. Although they are citing the medical social science literature, this mirrors arguments from writers such as Wynne (1992a; 1996) in risk and the public understanding of science.

Williams and Popay (1994) extract 4 key themes from the literature regarding lay knowledges/theories of health and illness:

i) lay beliefs are many and varied
ii) they are logically consistent and coherent, even when the empirical contents are at variance with accepted medical science
iii) They are biographical – narratives of the relationship between illness and life as a whole
iv) They are culturally formed within certain systems of belief and action.

Similarly to Irwin (1995), they point out that lay knowledge may incorporate expert knowledge, but has to be re-interpreted in terms of the experience of everyday life. The methodological implications of this require a phenomenological and egalitarian approach that challenges the method of medical science.

Williams and Popay use case examples to illustrate the problematic relationship between scientific expertise and the public, and argue that "real life public health issues exist in a murky borderland between science and opinion" (undated:57). However they fail to go any further in tackling difficult questions of how such disjunctures may be resolved, what may be done in such cases where lay knowledges seem to contradict scientific evidence, and how such situations should be managed.

A slightly different angle on lay knowledge and public health is taken by Brown (1992), who is often cited in the public health and risk literature. He uses the term 'popular epidemiology' and defines it as: "the process by which laypersons gather scientific data and other information, and also direct and marshal the knowledge and resources of experts in order to understand the epidemiology of disease" (1992:269)[2]. He also says, "it involves social movements, utilises political and judicial approaches to remedies, and challenges basic assumptions of epidemiology, risk assessment and public health regulation." (1992:269). Brown thus puts an emphasis on political activism and social organisation. He gives a set of stages of citizen involvement which include recognition of a problem, formation of a cohesive group which seeks information from officials and scientists, bringing in their own experts, engaging in litigation, and pressing for official recognition of their findings by official experts and agencies.

This fits in with Popay and Williams' second point about the political challenge to institutionalised knowledge, but falls short of their first point of an epistemological challenge, as to Brown, the layperson's knowledge is not to a major extent formed on a different epistemology of contextual, localised, anecdotal, qualitative information, but utilises scientific method and even relies on scientists themselves. Brown does draw on a constructionist perspective (Latour) and argues for a recognition that the social context of science means that it tends to work to support the political and economic status quo. However his argument is essentially about the production of science by and for institutions, rather than a challenge to the values and claims of science and scientific

[2] this same quote however is attributed in Irwin (1995) to Watterson (1991).

method such as Wynne makes. In fact, Brown explicitly writes, "such [lay] knowledge is not 'folk' knowledge with an antiscientific basis. In most cases, popular epidemiology findings are the result of scientific studies involving trained professionals" (1992:278).

Brown argues that mainstream epidemiology, or science, has a set of assumptions about causality, the political and public role of scientists, and corporate and social responsibility, and popular epidemiology is a socio-political critique of this. He urges for greater citizen participation in agenda-setting, identifying problems and working to establish their causes. He points out that the level of significance required by strict epidemiology to pass as conclusive will be higher than that required by a community to constitute a significant risk (citing Ozonoff and Boden 1987 who distinguish between statistical significance and public health significance). Brown does contend that lay rationality yields data unavailable to scientists, but does not explain or expand on this. The thrust of his argument is to politicise the production of science and call for more citizen participation in this process.

On fairly similar lines to Brown is Bloor (2000) with his study of 'Miner's Lung', an occupational disease of Welsh miners. By archival analysis, he found evidence that since the 1920s and 30s there had been a 'popular epidemiological' understanding among miners of the health threats of dust-generating mechanisms, which had led to some opposition to the introduction of new mechanisms on these grounds. Taken this way, this is similar to Wynne's idea of local knowledges. However the main interest of Bloor's paper is in looking at how the lay public can influence medical knowledge and the research effort, and again concentrating on their doing this through 'the instrumental use of expertise'. Thus Bloor describes how the miners, in their struggle to secure compensation for 'Miners Lung' as a recognised occupational disease, exerted political pressure to secure research funding, bought in expertise and even at times 'duped' experts (regarding their level of exposure for example) in order to secure favourable decisions in the courts. Bloor's study emphasises the relationship between a lay public and medical scientific knowledge as instrumental – and in this sense it is a more self-aware and even cynical relationship than in Brown's analysis. The situated knowledge of disease among sufferers and their associates became scientific orthodoxy through enrolling and even manipulating experts and through political lobbying. Both Bloor and Brown's studies also show how experts are seldom a unified group, even within disciplines, but rather fractionated, and differentially open to 'lay' arguments and interests.

Davison *et al.* (1992) are cited in Irwin (1995), in the public understanding of science literature but are nevertheless talking about lay epidemiology. Their version is that lay epidemiologies occur "where cases of illness and death from personal observation, histories known through personal and kin networks, media reports etc are discussed and analysed" cited in Irwin 1995, p128. Thus they have a function of addressing fundamental existential questions. To Irwin, this case provides further evidence for his concept of lay knowledges as incorporating elements of technical knowledge and epistemology, but at the same time involving a broadening out to address social and cultural dimensions. This interpretation of lay epidemiology also provides room for recognising a somewhat different epistemology by which the lay knowledge may be formed, through an emphasis on personal observation and anecdotal evidence.

An interesting empirical study of the significance of lay epidemiology and its relationship with expertise is that of Whittaker (1998). The study combines an anthropological perspective with Brown's concept of popular epidemiology and community mobilisation. It took place in an Australian community called Oceanpoint, which had expressed concerns about a possible excess of cancers due to environmental contamination. Oceanpoint had once been a coal mining community, but had undergone major changes including the closure of the mines, and the development of more prestigious housing, which had been accompanied by increasing social divisions. The 'reality' of exposure to toxic waste was ambiguous and had never been verified. Unlike most other studies however, the 'lay' community held varying theories about the possible cause of the perceived excess of cancers. Some attributed them to leaching of toxins from the local dump into the water table, others felt the cause was radioactive waste. Still others believed that the cancers might not be a significant excess at all.

Whittaker describes the pattern of community involvement in the issue in terms of Brown's stages and asserts that a key theme in the case is the difference between lay and professional ways of knowing. A study undertaken by the Public Health Unit found no statistically significant excess of cancers, but admitted limitations in the analysis due to data inadequacy. Some local residents felt the methods chosen to be inappropriate and even an attempt to obfuscate the community's claims. The local GP was enlisted by the community – possibly an instrumental use of expertise – which Whittaker interprets as an attempt to present local discourse in a form acceptable to medical authorities. Whittaker marks out competing knowledges and their unequal recourse to claims of legitimacy, but offers little way forward in the event of uncertainty and lack of consensus.

At the same time, however, Whittaker aims to link theories about cancer and its causation with issues of identity and the cultural politics of place, particularly the sense among older residents of a community having lost its roots and unity, and losing control over its future. She quotes from Walker (1989:245) "in the community, as in our personal lives, one kind of concern may be hidden in the language of another". Thus Whittaker sees concerns over cancer in Oceanpoint as serving as a metaphor for loss of control, with authorities, industries and developers appearing as the 'they' who control decisions about the community.

Whittaker is bringing together two somewhat different perspectives here. In her analysis of the politics of knowledge and legitimacy of knowledge claims there is an implication that the community's concern about cancers is (or should be) legitimate at face value, but is discounted for reasons related to power structures. In the more symbolic analysis however, the implication is that lay concerns over cancer are a metaphor for concerns over community cohesion and control. It may well be that both these levels exist simultaneously, and this seems to be what Whittaker is postulating, as she writes "the perceived threats to the health of residents of Oceanpoint owe as much to representational and symbolic realms as to material evidence and the paper illustrates the disjuncture frequently occurring between the two" (p314). However it reminds me of the concern of Kaprow (1985), and Phillimore (1998), that strongly social constructionist stances on environmental risks allow little space for examining the physical reality of toxic effects. The symbolic analysis would seem to detract from the strength of the more political analysis. It is arguable whether Whittaker is in a difficult somewhat contradictory position, or else offering an insightful analysis of how knowledges and discourses function on multiple levels and can be viewed through realism and constructionism without these being in irreconcilable conflict.

In summary, then, themes from the literature on lay knowledge and public health have clear parallels with those from the risk and public understanding of science literature, and indeed the two literatures start to merge with work such as Brown (1992). Again, there are different interpretations given to the status and significance of lay knowledge. The view within biomedicine is largely that lay knowledges should be understood in order that lay people can be communicated with better, with the aim of improving their understanding in line with the biomedical view. Williams and Popay (1992; 1994) take a much more critical stance close to that of Wynne (1992) and see lay and expert knowledges as epistemologically divergent, reflecting different power interests. Difficult questions about the validation and legitimacy of such divergent knowledges however are less addressed. To authors such as Brown (1992) and Bloor (2000) the interest is more in how lay people become involved in scientific knowledge production or co-opt expertise in order to promote their own interests, but the challenge is less clearly epistemological. In all these critical perspectives, however, the emphasis is again on the power relations behind knowledge production and how knowledge becomes seen as legitimate. Finally, Whittaker (1998) combines analysis along such lines in an empirical study with a parallel analysis of how lay understanding of a public health situation may also have significance on a symbolic level, signifying and expressing wider concerns about the social fabric and autonomy of the community.

2.5 PERCEPTIONS AND PUBLIC UNDERSTANDING OF AIR POLLUTION

2.5.1 Work from the 1960s-1980s

Research on public perceptions of, and attitudes towards, outdoor air pollution or air quality started in the late 1950s and the 1960s. The early studies were carried out in the US, with isolated studies then occurring in a number of other countries[3]. A large part of this body of work was carried out by behavioural scientists and psychologists, corresponding with the emergence of environmental psychology as a sub-discipline within psychology. Many researchers drew on the natural hazards research, (as reviewed by Burton and Kates 1964) on people's perceptions of natural hazards and behavioural responses toward their occurrence – and applied a similar design and rationale to a parallel study of the man-made hazard of air pollution.

From this precedent, and in keeping with the trends in social research at the time, most of the 1960s and 1970s research was by questionnaire survey administered to a sample of the population in towns where air pollution was considered to be a potential problem. Taking a basically naïve realist (Gibson 1981) and positivist perspective to the problem, these studies generally set out to measure what perceptions (in a broad sense) of air pollution were among the population, and how this related to the actual level of pollution as measured scientifically. As the common roots were in natural hazards research, this approach is the equivalent of other research in the broader area of risk at this time, and has been widely critiqued within later risk literature for taking a science-centred view of what constitutes the 'risk'.

The issue of air pollution at the time was seen very much as one of industrial and to a lesser extent domestic pollution – the character of the pollution tending to be visually obvious and sometimes accompanied by an odour problem. This is somewhat different

[3] Kromm (1973) in Ljubliana, Yugoslavia; Wall (1973) in Yorkshire, UK; Bladan and Karan (1976) in Chotanagpur, India; Thouez and Singh (1984) in Quebec province, Canada; Navarro *et al.*. (1987) in Santiago de Chile; Zeidner and Schechter (1988) in Haifa, Israel.

from the character of pollution faced in most large cities in developed countries today, where pollution is largely traffic generated and tends to be less visible.

Looking at this body of studies from the 60s to 80s there are some interesting and relevant findings with a certain measure of agreement across studies, places and time. Several studies found levels of awareness or concern to be related to measured levels of pollution (Arsdol *et al.* 1964; de Groot *et al.* 1967; Wall 1973; Thouez and Singh 1984; Bladan and Karan 1976; Zeidner and Schechter 1988) – perhaps through the importance of direct sensory perception (Medalia 1964; Wall 1973; Thouez and Singh 1984). Further than this however, socio-demographic factors seem to affect levels of concern, particularly socio-economic status, class or occupational level, with higher socio-economic status being related to greater concern (Smith *et al.* 1964; Medalia 1964; Kromm 1973; Zeidner and Schechter 1988 – but not Arsdol *et al.* 1964), race (Arsdol *et al.* 1964 and Swan 1970 found whites more concerned) and possibly age (Kromm 1973 found older people more concerned – but Zeidner and Schechter 1988 found them less so). From some studies the indication is that among less advantaged groups, although air pollution may be considered to be there and to be a problem, other social problems are seen as more pressing (Arsdol *et al.* 1964 and Swan 1970 among blacks; Bladan and Karan 1976 in India; Kromm 1973 in Yugoslavia). Interestingly there is some indication that concern over air pollution may not lead to or stem from a dissatisfaction with the locality overall (Smith *et al.* 1964; Medalia 1964) but rather overall satisfaction may lead to greater concern. What exactly the concern was about was not often explored; level of concern over health issues seems very variable among the studies and may relate to whether questions were open-ended or gave prompted answers.

Some studies indicate that habituation to higher or long-term exposure may occur (Evans *et al.* 1982; Kromm 1973; Thouez and Singh 1984) but this is contradicted by others (Medalia 1964). Habituation however could be due to different processes – Evans *et al.* see it as possibly an adaptive process affecting physical perception, but it could be an emotional response related to denial that is highlighted by others, e.g. Creer *et al.* (1970) on denial due to economic dependency. Also related to denial is the tendency shown in some studies for people to locate the problem elsewhere or to blame others for it (Thouez and Singh 1984; Kromm 1973; Wall 1973) – this is interesting and relates to some recent risk literature e.g. from Lupton (1999) and Joffe (1999) on risk and blame.

Apart from denial, evidence for other psychological factors is scrappy – Larrain Navarro *et al.* (1987) implicate trait anxiety in concern over air pollution but Zeidner and Schechter (1988) found that trait anxiety and anger led to lower willingness to pay for change.

In terms of coping behaviour there is some discrepancy in the studies in what is termed 'active' and 'passive' so comparison is a little difficult. Overall the indication is that few people make complaints (Swan 1970, 1972) – strategies such as closing windows seemed most popular (Zeidner and Schechter 1988; Wall 1973; Kromm 1973). In Medalia (1964)'s study, the more concerned were more active, but for Thouez and Singh (1984) the more exposed people were more passive – perhaps again related to denial – but again discrepant results may be due to different definitions of active and passive.

Due to the conceptual approach and survey methodology of most of the above literature, the conclusions are mainly descriptive and there is limited possibility of understanding the processes behind these results, or why some of the differences between studies may have occurred. Differences may be significant in terms of the location of the studies, the time at which they were done or cultural and social characteristics of the populations – more humanistic or constructionist models or critiques would emphasise this - or they may be artefactual due to differences in sampling, numbers surveyed, construction of questions, analytical categories and so on – a more positivist explanation.

One particular methodological concern raised in the use of this survey methodology and mentioned by some authors particularly Smith *et al.* (1964) and Swan (1972) is the discrepancy in levels of awareness and concern inferred depending on whether respondents were asked directly how much they thought air pollution was a concern locally, or whether they were asked a broader, open-ended question and assessed on whether or not they raised the issue spontaneously. Wall's (1973) study attempted to overcome this by giving open questions followed by more closed questions with a set of responses.

Many authors offer speculations on the reasons behind their observations, but from this body of work there is a clear need for further research using different methodologies to be able to look at these in more depth. These studies in particular demonstrate that there is a real opportunity for more qualitative research to be able to contribute to the understanding and offer some more analytical insights. A conceptual framework moving beyond positivism and naïve realism and according more importance and depth to people's understandings of air pollution, and a recognition of the contextual nature of these understandings, would also allow better insights into this aspect.

2.5.2 More recent work and theoretical developments

Despite a flourishing of research in other areas of environmental risk, there is a noticeable gap in research on the social dimensions of air pollution risk from the late 1980s to early 1990s. At this point, the topic once more seemed to be on the agenda and some interesting work has been the result, with some more developed methodological and theoretical perspectives brought into play compared to previous work. In particular, these studies start to address relationships between lay knowledge and expertise, and to address the role of context in shaping lay knowledge and understanding of air pollution.

An excellent study tackling a community's perceptions of the health effects of air pollution and considering questions of the role of lay epidemiology compared to that of classical epidemiology is that of Moffatt *et al.* (1995). This study was of a population living close to a coking works in Tyneside, England. A standard epidemiological study had been undertaken in response to public concern and data about public views and concerns was originally collected as a by-product of the epidemiological survey. Moffatt *et al.* however decided that both types of data were important. They point out that within traditional epidemiology, popular beliefs tend to be seen as an obstacle to achieving an objective study. Classical epidemiology works on the assumption that variables can be held constant in order to compare like with like, while studying lay knowledges assumes a diversity which is the antithesis of holding variables constant. They make an apt summary of the disciplinary contrasts:

> "the further studies of health are removed from the laboratory, the more difficult it is to screen off the intrusions of an array of potential social influences – whether confounding (to the epidemiologist) or compounding (to the sociologist)." (1995:890).

In putting aside local concerns and context, they argue, an epidemiological study may be distorting the reality it seeks to describe. On the other hand, they assert that focussing on ways of thinking and experience, without reference to causation, is incomplete as it ignores the contrasting material conditions and constraints shaping people's lives. Thus their view is essentially a pragmatic one for the use of combined approaches in order to shed light on a real situation which has both physical and social dimensions. This echoes the arguments of Popay and Williams (1996) and Blaxter (1990) from the health literature, that the biological and social dimensions of (public) health are interlinked.

The data on people's own views and experience came from the survey administered to a random sample in 3 areas: one close to the coking works, one a little further away and a control area much further away. Some was to coded questions and so treated quantitatively, whist other questions were open ended and provided more qualitative data. They found few differences in self-reported general health among areas, but a significant trend in reported children's health, improving from inner to control areas. There was a sharp gradient when asked specifically about the effects of local industry on health, more that 40% of adults from the inner area feeling adverse effects and 34% reporting effects on children. Estimates were higher for people they knew well rather than selves. The problems that were attributed to pollution were specific: upper and lower respiratory tract disorders, and wider concern about a dirty environment. In terms of what people felt put their health at risk, stress from pollution outweighed smoking, money, work, diet and all other factors in the inner area, with a highly significant trend across all 3 areas.

The qualitative data from open-ended questions showed frequent unease and worry – but not conviction - about the health effects of emissions in both study areas. Unease was mostly expressed along with observations of smoke and dust inhalation, as a kind of reasoning from evidence.

The epidemiological data showed a significant excess of some but not all respiratory conditions: chronic phlegm, sinus trouble, glue ear, allergies and headaches all had a gradient from inner to outer to control areas. Asthma and bronchitis showed minor, not statistically significant differences. GP consultations for respiratory complaints also strongly correlated with air quality in the study area but not in the control area; no such association existed for non-respiratory complaints.

The researchers point out that, from an epidemiological point of view, self reported health, stress and visits to the GP could all be attributed to 'awareness bias' - sensitisation due to prior concern, and resultant anxiety-based symptoms. Moffatt *et al.* argue however that ignoring such evidence and discounting the views of those exposed could result in potentially damaging health effects being overlooked – the epidemiologist's tendency to favour false negatives which Brown (1992) highlighted. Furthermore, they argue, by ignoring the social context, the data is compromised.

The paper concludes with five reasons why public concerns should in this case be considered 'in certain respects well founded'. Perhaps not surprisingly, most of these reasons revolve around the convincingness of the patterns observed, especially in contrast to the control area, with a last point that more recent modelling has shown that emissions may at times have been higher than previously realised, thus invalidating the original toxicological assumptions. Here, Moffatt *et al.* are applying pseudo-scientific validation criteria to the lay knowledge data, and with the last point, retreating into scientific verification. They are right that the evidence is compelling and makes a convincing case.

However they fail to address more philosophical and political issues about how lay knowledge should be evaluated, particularly in the absence of scientific data with which to verify it, or even when in conflict with current scientific evidence. Despite this, the study is excellent in terms of its application of divergent approaches in order to approach a real situation in a sensitive way and at the same time produce a rigorous study that provides conclusions based on convincing data.

In other work, however, Phillimore (1998) and Phillimore and Moffatt (1994) take on a more sociological analysis, and with references to social theories of risk, frame such situations in terms of competing narratives. In the 1994 chapter they acknowledge that in practice, popular epidemiology often makes recourse to biomedical criteria in order to justify local knowledge and cite Brown (1992) as an example. Phillimore (1998) is against taking a strong social constructionist view of risk, and still sees the necessity for realism in understanding the physical nature of environmental health problems. However, in a study concerning industrial pollution in Teesside, he here looks more explicitly at the politics of knowledge and interpretation of evidence: how a particular interpretation becomes dominant "is to go to the heart of the way that political and economic processes shape health understandings" (1998:203). In the Teesside study, he shows how the interests of industry and the local authority (developers and planners) acted to use and present research findings in a discourse of reassurance about the effects of air pollution – a discourse in which medical scientists and researchers may become implicated. The effects of poverty and smoking were emphasised to the public for example, as an alternative discourse, which acted to minimise the possible effects of pollution.

Another study using a community survey to look at perceptions of air pollution and health is that of Elliot *et al.* (1999). This was of a 'disadvantaged' but cohesive neighbourhood in an urban industrial area in Ontario, Canada. The empirical results are interesting. 72% of respondents thought that air pollution would likely lead to health concerns for themselves and 66% for others in their household (this does not reflect the greater concern for others that other research has found). This was significantly higher for women and for the more educated. Respiratory health figured highly as a potential concern. Effects on lifestyle were also mentioned a lot – including not opening windows and not hanging out washing. In terms of information, 35% reported that newspapers and magazines were their main source of information, followed by TV (20%). The authors feel this to be consistent with other cited recent findings that people use their senses directly to assess air pollution levels. Few people took direct action, i.e. contacted government, industry or council officials. Elliot *et al.* conclude that sensate factors are the primary predictors of concern, i.e. odours, reported health and other impacts, and experience of pollution. In the case of black soot, having a person in the household with asthma was related to concern. People also worried about future health, and saw their concerns as health related – indicating a need for a wide definition of health in future research, to include psychosocial components (worry and concern for the future).

Over a third of those surveyed by Elliot *et al.* reported some aspect of industrial pollution as the neighbourhood aspect they disliked most, but respondents also experienced several positive aspects of their neighbourhood which were traded off against pollution-related dislikes. The authors thus argue that perceptions and concerns need to be seen in the context of people seeing a number of positive aspects in the community.

Similar to Moffatt *et al.* (1995), Elliot *et al.* (1999) found that their study findings complemented rather than contradicted those of the scientific experts (from a previous risk assessment). The authors felt that in this situation, one epistemological perspective did not seem to be privileged over another – rather, the community survey results gave weight to the case and added to the scientific study. They argue that people also need to see the decision making process as fair and inclusive in order to be happy with any final decision over planning or regulation.

Some attention to the role of context in forming perceptions of air pollution was given by Howell *et al.* (2002) looking at public views about air pollution, risks to health and air quality information in Teesside and Sunderland, UK. Teesside is an area dominated by heavy industry while Sunderland is characterised by light industry. This study looked for relationships of perceptions with personal factors, relative deprivation and district. This was done through a survey followed by qualitative interviews.

They found the strongest association with perceived pollution was with proximity to industry, those closest to heavy industry perceiving air quality as worst. After controlling for other factors, deprivation level had only a weak association with perceptions. There were few associations with personal factors; after controlling for deprivation those with chronic illness were more likely to rate local air quality lower and to rate industrial pollution as a serious problem. In the interviews, they found that the higher level of concern in communities closest to industry reflected problems related to nuisance – dust, smell and noise- but also concerns over potential health risks from air pollution or accidents. However, although the majority of people in this area were concerned about pollution, more were concerned about unemployment, crime and poor housing, and these problems were brought up much more in the interviews than was air pollution.

Howell *et al.* conclude that the presence of industry plays a key role in shaping perceptions of air quality and that the importance of place-based factors and not just personal factors should be noted when looking at influences on these perceptions. This seems rather an obvious argument taken in one way, or else a weak argument when taken another way. This paper suffers from looking only at perceptions with no reference to other data. Without necessarily privileging scientific knowledge over local knowledge, one would assume that in physical, realist terms the air quality would be worse in the neighbourhoods close to industry, so it is not at all surprising if this influences perceptions. If the implication is that there is something about the presence of industry other than the pollution produced which influences perceptions, then the paper fails to show this adequately because it does not evaluate or even address the physical dimension.

Another paper from the same larger study (Bush *et al.* 2001a) takes a more explicitly social constructionist stance. Here the authors analyse data from the qualitative interviews in Teesside using a theoretical framework concerned with ideas of stigma, based on the work of Goffman (1963, cited in Bush *et al.* 2001a) among others. They argue that

Teesside suffers from a spoiled identity as a place, 'discredited' on the basis of industry, air pollution, poor health and social exclusion - i.e. technological stigma, pollution (dirt) stigma, health stigma and social stigma. Air pollution and poor health, they argue, are used as discrediting characteristics to stigmatise an 'other' place as dirty and unhealthy, whilst confirming the cleanliness and healthiness (usualness) of the place(s) where those doing the labelling live. This exclusionary discourse is based on an idea of dirt as a signifier of imperfection and inferiority (from Sibley 1995, cited in Bush *et al.* 2001a). They argue the implications of this are that policies to improve the image of the area may be thwarted by the strength of the associations.

This is quite interesting but again could be criticised as taking too constructionist a stance about a physical reality. If a place is dirty, and people are unhealthy, is it stigmatisation for this to be recognised, and evaluated in a negative way? Does the stigmatisation in any sense go 'beyond' the physical reality, or how can these two dimensions be related? These are the interesting and difficult questions, which I feel are not adequately addressed.

Another question that this raises however has to do with the role of geographical context in shaping perceptions. Many have argued in various ways that concerns over a generally poor physical or even social environment may be expressed as raised perceptions of, or concerns over, a single environmental hazard such as air quality (e.g. Irwin *et al.* 1999, Whittaker 1998). The implication of a stigma theory however could be that the relationship is the other way, or at least two-way – that the presence of pollution causes the place as a whole to be 'discredited' and seen as bad. They do imply that stigmatisation is a process that takes place among outsiders, in order to make the place 'other', so it is hard to say what the initial motivation for this process would be; pollution could provide both a reason or a justification. However it shows that the relationships with context may not be simple.

The above recent work has all been concerned with perceptions related to industrial air pollution, and communities living close to very visible industrial plants. The work of

Bickerstaff and Walker (1999a, 1999b, 2001) is based on a study of perceptions of air pollution in Birmingham, UK where more diffuse pollution from traffic would be a major source, although industrial point sources in the vicinity were also a factor. Bickerstaff and Walker's study looked at perceptions of and behavioural responses to air pollution, as well as attitudes to policy practice including air quality information provision. They used a mixed methodology consisting of a questionnaire survey followed by one-to-one interviews. The study took place in 3 residential districts selected on the basis of socio-economic status, measured using education, occupation and car ownership measures – presumably the aim was to provide a range, but this is not entirely clear. Within the 3 areas the sampling covered a cross-section in terms of proximity to sources of pollution, both transport and industrial.

Over 56% of respondents were aware of negative air quality conditions (it is not clear how this is extracted from the questionnaire, but probably in response to a question asking them to rate air quality). When asked in an open-ended manner how this awareness came about, the single most important factor was health-associated impacts (22%) followed by different kinds of sensory evidence (totalling 29.1%, mostly visibility and smell.) The interviews also confirmed the role of sensory indicators in awareness and concern, for instance visible indicators of dirt deposits and pollution haze in the air (Bickerstaff and Walker 2001). The importance of direct sensory evidence concurs with many previous studies but the extent of citing health impacts may represent a development. They also relate this to literature on risk perception and personal experience. However the 44% not aware of a problem is higher than many previous studies, which the authors suggest may be due to the non-visible nature of much recent pollution, compared to the industrial and domestic smoke problem of earlier studies. In contrast to Swan (1972), but in agreement with Elliot *et al.* (1999) they suggest that the physical nature of pollution may be more important than media coverage in forming awareness. Only 3.4% identified the media in forming their awareness of bad episodes, and none cited government information. For those who were aware from the media this came mainly from news weather forecasts and was often not actively sought.

Direct questioning on the use of information sources found a limited awareness and use of sources of air quality information (Bickerstaff and Walker 1999). 10.3% used the media often, 38.9% infrequently and 50% never. Government sources were less popular: 5.1% using them frequently and 32.3% infrequently. Forty eight per cent of respondents used no information services at all, ever. The authors conclude that provision of information, or its use, is not enough to change perceptions, but I am not sure that this is a reasonable conclusion, as only 56% of people showed any awareness and 52% of people used some kind of information service at some time.

In terms of sources of pollution, 90% saw cars as significant and 49.5% as the principal cause, a reasonable reflection of scientific assessments. However buses and HGVs together accounted for more mentions than cars indicating perhaps a tendency not to see selves as the polluter. Forty one per cent saw industry as significant and 20% as the principal source. There was a positive correlation between age and the identification of industry as paramount, implying a reliance on past direct experience. Again the authors conclude that awareness is influenced by setting and lived experience.

The results concerning spatial awareness are interesting. Asked where they thought air pollution was worst in Birmingham, 40% used sources, mainly traffic arteries, to define this. Where areas were defined, the city centre dominated, which is the zone of maximum source concentration. References here were also made to the general untidiness, the lack of greenery and the density of buildings in shaping perceptions as to why air would be worse here. In all evaluative categories, people gave more positive ratings to their own local area than to Birmingham as a whole. As in previous studies, this could represent cognitive dissonance, or denial; Bickerstaff and Walker (2001) see this as a possible reluctance to draw a direct connection between city-wide and local air quality, and the attendant risks. However this may not be reasonable as the two could be quite different. Again, as no reference is made to any comparative physical data it is a little problematic to draw conclusions of denial.

Bickerstaff and Walker (1999) state that no relationship was found between socio-economic status (presumably at individual level) and perception or concern, which does not corroborate many previous studies. They suggest this may be due to a wider diffusion of environmental concerns across social groups. Women however showed more negative perception of air quality both city-wide and locally, and greater concern. However in the 2001 paper, they develop an argument concerning the influence of social class. Here they say that the least concern was shown in the high status neighbourhood, while stronger worries emerged in the low class area. They feel that although differences in physical environment may account for some of this, the fact that the area of medium socio-economic status was more concerned than the area of highest socio-economic status, despite having a similar level of satisfaction with their environment, is evidence of a class effect. This I feel is rather weak on two counts: first of all this is tenuous evidence of a class effect; it could have been made stronger by showing evidence of significant differences or trends between areas in the quantitative data, but no such evidence is presented. Secondly, there is no data regarding any of the physical dimensions of any of the areas, particularly air quality. The implication is that the sampling design ensured a roughly equal distribution of the physical hazard by aiming for a range of distances from sources, but this is a big assumption which may not be the case. It is quite possible that the physical levels of air pollution and other factors in the environment were quite different. As with Howell *et al.* (2002) above, the examination of the perception data alone with no reference to physical data weakens the argument. I do not intend to imply that the final validity rests with the physical data alone; however not looking at the physical data precludes a balanced assessment of what people may be responding to in their perceptions, and also can lead to a position of unwisely downplaying the physical dimension of the problem (see Kaprow's (1985) critique of Douglas' cultural theory, above). Elsewhere Bickerstaff and Walker strongly assert that people's perceptions are formed largely through sensory perception, which raises the possibility even more that physical differences could be the cause of perceptual differences.

Some of this criticism is addressed in Bickerstaff and Walker's examination of the possible reasons for a class effect. First, they say, this could be due to logical processes based on source proximity and the physical environment. The presence or otherwise of greenery appeared to be significant, as did the level of physical management – litter, dog fouling etc. This has an indirect relationship with poverty. Second, there is a possible role of financial empowerment. Those who choose to live where they live see it as better; for poorer people residence is dictated by restricted economic opportunities and so they may exhibit more dissatisfaction. Thirdly, it could be due to a reluctance to recognise negative environmental conditions particularly when satisfaction is high – a case of denial or cognitive dissonance regarding the risk, or unwillingness to acknowledge vulnerability. This is possible, but unresolved without some recourse to looking at levels or proximity of sources. It assumes that these are equal, but this may not be the case.

The authors argue that these three explanations can be linked, with the implicit conclusion that deprived areas have diminished air quality, poor physical environment and a lack of empowerment to achieve change. A negative social and physical environment also leads to a propensity to dislike the neighbourhood and attach negative attributes. Thus there is circularity in the determination of perception, and the environment is perceived holistically, not as separate disparate factors. This recognition of holism in forming perceptions is potentially important. However the authors do not really offer any evidence for any of the three explanations or evaluate which is most likely, and so their argument remains somewhat unsubstantiated.

In terms of the effects of air pollution, direct health impacts were found to be the most important, while less immediate environmental impacts did not emerge as an issue. Thirty eight per cent identified some impacts other than health, short-term damage to the natural environment being highest. A weak association between identification of non-health impacts and income and with occupational status was observed. In concurrence with earlier studies, concern over wider impacts may be higher in higher social classes, but health concerns seem to be across the board in this case, as observed earlier.

Forty five per cent claimed to experience in themselves or in the family health problems attributed to air pollution, highest being asthma, then other respiratory complaints, and hayfever or allergies. When asked about level of concern, 53.2% claimed a high or very high level of worry over local air quality, and 50% were concerned or very concerned about personal and family health impacts. Not surprisingly, measures of concern and worry were correlated. A higher level of concern was exhibited for the health of family relative to respondents' own health. In the interviews (Bickerstaff and Walker 2001) few people identified personal health impacts but the majority made a connection between air quality and health at an abstracted societal level. This corroborates much previous research, but Bickerstaff and Walker go on to look for explanations for the 'partial links' that people make between air quality and health. This seems rather normative – i.e. it is implied that people should be identifying health impacts on themselves, when this may be problematic with a relatively small and not representative sample.

Bickerstaff and Walker (2001) give one possible explanation of these uncertain links as being causal uncertainty resulting from one environmental component being divorced from its context - other environmental components may then be offered by people as a possible explanation or are seen to confuse the establishment of causation, e.g. poverty or weather. The health relevance may also be attributed to a minority group with particular health problems. The authors see this as a 'perception gap' – a reluctance to acknowledge personal and local vulnerability, which again they see as possible denial or cognitive dissonance. Secondly they say it may enable individuals to relinquish responsibility – for example the responsibility of polluting by driving. However there is again no evidence for either of these explanations – for example they do not look at the difference between drivers and non-drivers in patterns of survey responses.

One of the main conclusions of Bickerstaff and Walker's work is that air pollution as an environmental risk is experienced very much locally and through lived experience. There are reasons for this conclusion, but sometimes evidence is lacking. In particular the lack of physical data on the different neighbourhoods weakens some of the arguments, for example the argument that people exercise denial with respect to the risks in their own neighbourhood. Their conclusion that external sources of information and expertise have minimal influence on people's perceptions may also be problematic; there is room for more exploration of the relationship with expertise in particular.

Bickerstaff and Walker's conclusions about the localisation of experience lead them to the policy points that information will be judged as irrelevant if it does not engage with people's own experience, and therefore professional bodies must actively seek and engage with public understandings of air pollution. They advocate community involvement approaches and argue that local institutions are best placed for such endeavours. These points are also made in a separate paper evaluating air quality information (Bickerstaff and Walker 1999b) where they reiterate that people evaluate information sources through a process of contextualisation and sense-making in relation to their real lives, and also their conclusion that people relate to air quality and air quality information most at a local level.

These latter points are similarly made by Bush *et al.* (2001b) in relation to air quality information: based on their research in north-east England (see Bush *et al.* 2001a discussed above) they also assert that the public do not passively assimilate scientific information, but rather "the social validation and legitimisation of expert information is actively negotiated in relation to a range of resources, including experiential and local knowledge" (2001b:215). They found that many people did not feel air quality information to be relevant to them because they were not affected by it, but that even those who did feel affected, for example asthma sufferers, often did not find the information useful because they were powerless to change the situation. Their interviewees felt that only scientists had the technical ability to measure air pollution, but nevertheless scrutinised air quality information for validity, reliability and trustworthiness, using everyday experiences to do so – a process that the authors see as reflection on the 'epistemological status' of the information. Again, they advocate public participation and consultation in order to develop a more meaningful system of information provision.

The work of Yearly (Yearly 2000, Yearly *et al.* 2003) provides an interesting and more concrete study of why and how local knowledge may be combined with expert knowledge and information. Yearly again is using a theoretical framework from the public understanding of science literature, particularly Wynne, which emphasises the discontents that may arise when expert accounts are in conflict with local knowledge. Yearly's work used group interviews with local people to evaluate an air pollution model in Sheffield. The respondents questioned the assumptions of the model, its operation and the suitability of sites chosen. They were also concerned about opportunity costs and questioned the usefulness of an expensive model to provide information when they were not able to do anything about the situation anyway. Issues of trust in the council in the way that the model might be used were also raised.

Participants drew on their local knowledge of traffic patterns and of operating practices in local industrial point sources to question some of the model's output, and were able to add useful information. In the further study, extended to Bristol and York, the groups produced spatial representations of their local knowledge of pollution, which were then digitised into maps. These maps showed a high level of correspondence with the experts' models, but areas of divergence were interesting in the light of the local knowledge that was being used. The citizens' maps were found to be very credible and to provide a very useful complementary source of information to the model.

This is to date the most practical work on developing a method and practice by which local and expert knowledges may be combined in the context of local air quality management. However it should still be noted that the public in the final analysis did question the overall usefulness of the model and the information it could provide anyway, given what it would cost, and issues of trust relating to its use would potentially still remain.

This more recent body of work on public perceptions and understanding of air pollution has thus started to build more theoretical insights and arguments, particularly regarding the role of lay knowledge. Lay knowledge on the whole has been argued to make a valuable contribution to understanding and addressing air pollution, both substantively, and in order to maintain public confidence and trust in decision making and regulation. Several studies have argued that lay knowledge is formed mainly through personal and localised experience and thus is contextual in this sense, and that public information is seen as less relevant.

Concerns about the health effects of air pollution have been more specifically addressed than in earlier studies and have been found to be important, which may represent a development from previous decades. However the lay epidemiology of the effects of air pollution is still relatively under-explored in detail.

The role of context in these more recent studies has been highlighted but addressed piecemeal and in quite different ways. Geographical context has been highlighted in the sense that proximity of pollution sources has been shown to affect perceptions of air quality (Howell *et al.* 2002) and in a different sense, in that perceptions of air pollution may reflect or help constitute an overall stigmatisation of a place (Bush *et al.* 2001a). Others have argued for the need to see perceptions of one environmental risk in the context of overall feelings about an area, which may be good or bad (Elliot *et al.* 1999, Bickerstaff and Walker 2001). On the whole there has been a move to recognising that perceptions of an environmental risk may be made holistically, along with other judgements and concerns. Social context has been recognised as a factor in that links between deprivation and perceptions have been argued for to some extent, though the reasoning is as yet inconclusive; and other correlations with social factors have been observed.

2.6 CONCLUSIONS AND RESEARCH QUESTIONS

Conceptualising air pollution as an environmental health risk gives an array of theoretical tools for understanding how people understand it and what it means to them. At the basis of many of the differences in theoretical perspectives is the spectrum in epistemological and ontological terms from naïve realism to strong social constructionism. The naïve realist: constructionist tension is apparent in early risk theory and can be traced throughout the literature, up to and including very recent work specifically on perceptions of air pollution. At the same time however there is increasing recognition from both public health and risk fields that physical and socio-cultural aspects are linked in real life risk situations and both are part of the risk.

The risk literature has turned to address the changing nature and significance of risk in society. This interest has led to conceptual and empirical work regarding the distribution of hazards and risks in society; and the place of science and other forms of knowledge in understanding risks. In these concepts, ideas about context start to become important, although it is treated in different ways.

Work on environmental equity forms a kind of social geography of environmental risk from a relatively naïve realist and positivist perspective. The hazard and risk are that which are physical and measurable – both in terms of the presence of pollution and its potential effects; and context is addressed in the form of spatial position, and quantified and aggregated demographic variables. However the experiential dimension, in understanding how the impact of the risk is felt and understood, is lacking.

Health geography has been rather more rigorous and focused in its treatment of the role of context, and this field has developed an array of approaches to understanding contextual affects, ranging from the material to the symbolic, and the positivist to the humanistic. These ideas are potentially useful in the conceptualisation of how context might be important in understanding and experiencing air pollution.

More humanistic or constructionist takes on risk and the public understanding of science, and also on public health, have developed work on lay knowledges and their relationship with science and expertise. The role of context in knowledge formation has been important here, leading to concepts of local knowledges. Different authors have understood the significance of lay knowledge in somewhat different ways, some seeing it as a political challenge to expert institutions, whilst others see it as an epistemological challenge to science and a particular accompanying set of social relations.

In understanding public perceptions of air pollution, all these perspectives have been relevant, leading to a number of valuable contributions but a relatively disjointed literature. In older studies, a more positivist approach predominated which gave some useful insights into possible contextual effects on perceptions such as the role of socio-economic status, or economic dependency, but the paradigm limited theoretical understanding of these relationships. More recent work has generally favoured a more constructionist paradigm with an interest in perceptions as local knowledges, but has sometimes been weakened by failing to pay due attention to the physical dimension of the hazard and risk. In this work, a swing from the survey methodology of the early studies to a greater interest in qualitative methods accompanying the later constructionist stance has been apparent and this has implications for both theoretical conceptualisation and empirical findings. It should be noted however that the later work on perceptions of air pollution has incorporated several studies using a mixed methodology.

This thesis aims to use these theoretical tools to investigate empirically public perceptions and understandings of air pollution and its impacts. In doing so, the aim is also to contribute to theoretical understanding regarding issues of equity, competing knowledges, and the role of context, and to work towards addressing some of the conceptual gaps and shortcomings identified in this chapter. The research questions of this work are thus as follows:

1. **To what extent are concepts of risk helpful in understanding people's perceptions of air pollution risks?** This particularly refers to the tension between naïve realist or positivist and constructionist paradigms at the basis of different concepts of risk.

2. **What are lay perceptions of air pollution, its nature and its effects?** What do people think regarding where air pollution comes from; what their air quality is

like; what the effects of air pollution might be, particularly the health effects; and how it impacts on themselves?

3. **How is lay understanding of air pollution, its nature and its effects formed?** This question is related to theories about lay knowledge, its epistemological characteristics and its relationships with expertise.

4. **To what extent does social and geographical context influence lay experiences of air pollution, its nature and its effects?** Context may be important to all the above questions; the aim is to evaluate if this is the case and investigate in what ways context has an effect.

5. **How do different methodologies contribute to understanding perceptions of air pollution?** A final area of interest is methodological: whether and how using both qualitative and quantitative techniques may benefit such a study.

I now turn, in chapter 3, to a discussion of the choice of methodological strategy for addressing the above questions.

CHAPTER 3

Methodology

Different theoretical approaches to the study of perceptions of environmental risk and of public health have tended to be allied with different methodologies. More naïve realist approaches have generally relied on quantitative techniques, whilst the turn to more social constructionist approaches has been accompanied by a turn to qualitative methods, which are seen to capture better the perspective of the research participants, and also to be less alienating and less imposing of a hegemonic scientific rationality (e.g. Wynne 1992b, Williams and Popay 1994).

Early work on perceptions of air pollution, as discussed in chapter 2, relied heavily on survey methodology. These studies found some interesting links between socio-demographic variables and perceptions, but the methodology restricted their ability to understand why and how these relationships might occur. More recent work has favoured a greater use of qualitative techniques, but evidence for theories linking perceptions to other contextual factors has sometimes been weak due to small sample sizes and a minimal basis on which to make comparisons.

The fieldwork for this thesis employed a mixed methodology of both qualitative and quantitative elements. The aim in doing so was to gain from the advantages of each, and put simply, to achieve a depth and subtlety in understanding peoples perceptions and the reasoning behind them, as well as reaching a reasonable sample of people and being able to look for relationships between perceptions and other variables. The two elements took place sequentially: a first phase of semi-structured qualitative interviews was followed by a social survey, which was analysed quantitatively. The two phases were conceived to be equal in merit; each was to stand alone as piece of research in its own right, but would complement the other to produce a whole with a greater insight than either phase alone.

The use of such a mixed methodology inevitably raises questions about epistemological positioning; in this chapter I will discuss some epistemological and ontological concerns, before describing the procedure by which the data collection and analysis took place.

3.1 RESEARCH DESIGN: THE USE OF MIXED METHODOLOGY

To some extent there are disciplinary traditions about methodologies, which reflect the substantive interest as well as the epistemological and ontological position of the disciplinary approach. For instance anthropology, studying cultures and systems of meaning, has favoured ethnographic, largely qualitative approaches where the researcher is fully immersed in the situation (although traditionally the position of researcher as semi-outsider with privileged understanding was not problematised), while cognitive psychologists with a naïve realist view of human cognitive processing favoured positivist approaches and methods such as observation and surveys, with the researcher seen as objective outsider. These traditions have been very much reflected in risk research. Interdisciplinary research however offers the possibility of breaking out of such traditions and putting together new methodological strategies. Geography is well positioned as a discipline for such research to happen, as it is one discipline which has traditions in both qualitative and quantitative approaches, and where extensive ontological and epistemological debates have been played out (see e.g. Cloke, Philo and Sadler 1991 for an exposition of key arguments).

Traditionally, the idea of hazard and risk was firmly based in a naïve realist and positivist paradigm. Measurements of riskiness as a mathematical function of measurable amount of harm (e.g. numbers of fatalities) and probability of occurrence were the norm. Early studies of risk perception were also realist in that they assumed a measurable amount of risk and sought to explain how people (mis)understood this. Later, more critical work on the social theories of risk as reviewed in chapter 2 has moved towards a more social constructionist perspective, in which the social perception or understanding of the risk is seen as part of the risk, or risk situation (e.g. Douglas 1985; Rayner 1992; Wynne 1992b). Along with this shift has been a turn to qualitative methods. Such authors as Rayner and

Wynne argue that the social relational aspect of risk is of primary importance, and that qualitative methods are the only means by which this can adequately be captured and understood. Wynne (1992b) argues that only qualitative methods such as ethnography are suited to understanding the contextual and changing nature of the identity and social relational processes which are at the heart of risk situations.

In addition there is sometimes a more political aspect to the choice of methodology. Wynne (1992b) for instance, as discussed in chapter 2, argues that it is the alienating effect of the imposition of hegemonic scientific realism and naturalism – extending also into social science – which can lead to conflict in risk situations. Quantitative methods based on a positivist epistemology are a manifestation of such alienating systems of knowledge. This is partially an echo, in the risk field, of arguments that have been very strongly expressed in particular by feminist geographers and social researchers, about the power relations of research methods (see for example Oakley 1990; Dyck 1993; McDowell 1992). They argue that quantitative methods impose a framework of meanings and labels on the researched which reflects the worldview of the (male) institutions and organisers, whilst devaluing the knowledge and meaning systems of the researched; and the methods' claims, (through a positivist epistemology,) to neutrality and objectivity allow this process to be hidden. Qualitative methods, on the other hand, feminist researchers see as more egalitarian and emancipatory and better for capturing what is important to those researched without imposing the worldview of the researcher. In addition, qualitative methods acknowledge the impossibility of claims to objectivity of the researcher and do not therefore claim to be neutral. In this way the power interests which may be at work through knowledge claims are more explicit.

The polarisation of the debate about quantitative versus qualitative methods in social science has often been due to the equation of specific methods with particular ontological and epistemological positions. Quantitative methods have been equated with naïve realism and positivism, while qualitative methods have been equated with a humanist and constructionist (social constructivist)[4] point of view. Remarks made about the suitability of various methods have therefore often been more to do with the assumed paradigmatic stance (Baum 1995). Employing a mixed methodology needs to find a tenable way beyond such polarisation.

One way beyond this binary opposition of positivist/constructionist, quantitative/qualitative is to take a so-called methodological pragmatist position (Tashakkori and Teddlie 1998; Cherryholmes 1992; Reichardt and Rallis 1994; Howe 1988). This is a position which is often favoured by researchers working in applied, policy contexts[5]. According to Tashakkori and Teddlie, pragmatists embrace a credo of "what works" (1998: 21) and they "consider the research question to be more important than either the methods they use or the worldview that is supposed to underlie the method" (1998:21). They tread a middle ground between positivists and constructionists on various points. Pragmatists use both inductive and deductive logic, and may employ positions of subjectivity and objectivity at different points in the research process. They believe that researcher values play a large role in conducting research and in drawing conclusions, but do not worry about it unduly; they acknowledge that they choose what to study and how to study it according to their value system (Cherryholmes 1992).

Pragmatists argue that while naïve realists believe in an external reality that can be determined, and constructionists believe that there are multiple social realities which are products of human intellects and can constantly change (Guba and Lincoln 1994, cited in Tashakkori and Teddlie 1998), pragmatists believe in an external reality but deny that truth can be determined once and for all (Cherryholmes 1992). According to Howe (1988) truth is a normative concept, like good, and knowledge claims cannot be abstracted from beliefs and interests. Pragmatists also believe that there may be causal relationships – unlike constructionists who believe that all entities are constantly shaping each other (Tashakkori and Teddlie 1998) - but it is probably not possible completely to

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[4] I am taking the terms 'social constructionist' and 'social constructivist' to be synonymous in this thesis.

[5] For example several of the proponents of methodological pragmatism cited here including Cherryholmes (1992) and Howe (1988) are education researchers.

pin them down. Results from any data set may be explained by multiple theories (Reichardt and Rallis 1994). The choice of one explanation or interpretation over another then is that which best produces desired outcomes (Cherryholmes 1992) or fits with the value system of the researcher.

This is an appealing system but it lends itself to a criticism of lacking intellectual rigour, and prioritising convenience over really working out some of the issues. It may not be possible to take a middle ground on all points as some may be incompatible (Sale *et al.* 2002). The issue of subjectivity and objectivity in particular is central to the debate and is hard to reconcile. To a strong constructionist, a crucial point is that the researcher is not and never can be objective: objectivity in this sense is an illusion. As the feminist researchers pointed out, this illusion of objectivity and neutrality may serve to obscure power interests. This may be one of the harder points to counter in using a mixed methodology with a pragmatist stance.

It should also be noted though that the characterisation of the two opposed paradigms of realism and constructionism given in these arguments is somewhat extreme and oversimplified.

'Social constructionism' is something of a catch-all term that in practice seems to be applied to a number of positions. Not all researchers who would characterise their work as being from a social constructionist or constructivist point of view would necessarily embrace ontological relativism to the extent that is portrayed in the arguments outlined above, for example in the definition given by Guba and Lincoln (1994). Berger and Luckmann (1966), in their seminal text 'the social construction of reality' appear at first sight to be ontologically relativist, but they stop short of this position, stating that they "disclaim any pretension to the effect that sociology has an answer" to questions such as 'what is real?'. Many more 'weak' social constructionists are therefore closer to the 'pragmatist' view of Cherryholmes (1992), that external truth cannot be determined once and for all, and that in research the choice of explanation is made according to the interests and values of the researcher: epistemological relativism rather than ontological relativism perhaps.

'Realism' as a philosophical position is also somewhat misrepresented by this oppositional approach. Realism, especially in the social sciences, has undergone considerable development since the late 1970s and in this more critical form has departed from the naïve realism that assumes that facts about observable phenomena can be objectively established and to which 'questions of unseen entities, problematics, abstract forms or subjective impressions are irrelevant' (Gibson 1981:153). Contemporary realism might be seen as having incorporated some notions of idealism[6] (Cloke *et al.* 1991) in recognising that although reality exists independently of ourselves it is only knowable through our concepts, but again a variety of positions is apparent within those defined as realism (see e.g. Bhaskar 1975; 1986; Harré 1986). Sayer (1992:5- 6) in defining realism, cites the tenets that 'our knowledge of the world is fallible and theory laden' and that 'science or the production of any other kind of knowledge is a social practice...the conditions and social relations of the production of knowledge influence its content', but that nevertheless 'knowledge is not immune to empirical check'. Contemporary realism in geography however developed partly as a critique of positivism and empiricism, and advocates a process of abstraction in order to disclose mechanisms and structures, by which theoretical categories inform and are informed by empirical material – rather than priveleging theory-free observations.

Another point in getting beyond the 'either-or' divide is that methods need not be seen as necessarily attached to particular paradigms (Carracelli and Greene 1993; Barnes and Hannah 2001; Sheppard 2001). The arguments perhaps should not be over which methods are used but how they are used and how the results are interpreted (Sheppard 2001). Mattingly and Falconer Al-Hindi (1995) for instance argue that it is largely the positivist epistemology of quantitative methods that feminist and critical geographers

[6] Idealism being any philosophy in which either reality is regarded as being constituted by the mind, or in which understanding is limited to perceptions of external objects (Johnston *et al.* 2000) – note connections with social constructionism.

have objected to, in particular the claims to objectivity and neutrality; others such as Sheppard (2001) explicitly reject the idea that quantitative methods are apolitical and neutral, and so it may be possible to use them within a non-positivist framework (Barnes and Hannah 2001).

Some commentators argue that methods do reflect a particular view of reality, and while this may not make them completely incommensurable, the only way to use them together is for complementary purposes, acknowledging that they are looking at different aspects of a phenomena, rather than for triangulation, which traditionally assumes they are looking at the same thing and should therefore agree (Sale *et al.* 2002). Nightingale (2003), a feminist anthropologist, took this position in a study of community forests in Nepal. Using photographs of land cover from remotely sensed images and interviews with members of the local community, she argued that results from different methods are all incomplete and give partial knowledge, and that linking methods is interesting not for triangulation but to provide opportunities for examining the partiality and situatedness of each kind of knowledge produced.

The interest of my research is on the perceptions, feelings, beliefs and experience of the public and my overall position could be characterised as constructionist. This lay knowledge I believe is partial, as is the scientific knowledge of the risk, and it is not the aim to evaluate the lay knowledge by reference to scientific 'reality'. However in policy-orientated research there would seem to be little room for a strong constructionism with an ontologically relativist position; in order to believe in the project of research informing policy to a degree which is more or less useful then one must to a certain extent believe in a reality to the situation, whether fully knowable or not. The reality in this extends to the reality of the social perceptions and beliefs, i.e. that they exist beyond the research situation. This is also compatible with a contemporary realist position, as outlined above. A further element of realism is brought in by my treatment of context. By looking at context as social and physical circumstances, which are constructs but as such are knowable and which do involve a certain amount of physical 'reality', I am assuming a degree of reality to the influences and relationships at work, a reality which is fairly context dependent and contingent but which is more stable than existing in the moment of the research situation and in my interpretation alone.

I believe that the interpretations I give and conclusions drawn are influenced by my ideas, values and my position in the research process. A different researcher may have obtained somewhat different responses and results. However I do believe that some interpretations will be 'better' than others, i.e. closer to the 'reality' of the situation.

I do not believe that either qualitative or quantitative methods are incompatible with this position. As with the interviews, I would acknowledge that the questionnaire is neither neutral nor objective and that to some extent possible results and interpretations are shaped by the structuring limitations of the method, and the categorisations which I as a researcher have chosen to impose. The use of numbers and statistics serves to impose a system on the phenomena in question which seeks a particular kind of explanation and perhaps limits the range of relationships which will be made visible. Interpretation of results needs to take these points into account.

However, not all mixed methodologies are the same. It seems more common in recent research particularly in the risk field for a mixed methodology to consist of a quantitative survey, followed by interviews and/or focus groups which probe some questions deeper or help to explain various aspects further (Langford *et al.* 2000; Desvousges and Frey 1989; Bickerstaff and Walker 2001). In such designs the initial framing of the research questions is much more in the hands of the researcher and the research is grounded in *a priori* interests. My strategy, in contrast, was to conduct the qualitative stage first, and base the questionnaire design on analysis of the interviews. In this way, the questionnaire was very much based on the issues raised by the interviewees themselves, and on themes emerging from the interviews which were of particular interest to me. In particular, the response categories given for many of the questions reflected points of view from the interviews and were sometimes in the interviewees' own words (see for example question 31). I did not attempt to evaluate whether they were 'reasonable' or 'correct'. This type of study design I feel is more sympathetic to the concerns and knowledges of the community being researched and better able to reflect their local or lay knowledge. Although the research participants were not directly involved in the design, in an indirect way this could be seen as approaching an opening up of quantitative methods to citizen involvement, as for example Hannah's (2001) suggestion of allowing categories for statistical representation to be constructed by those they represent. In designing the questionnaire based on the qualitative data, I feel that to some extent the concerns over the power politics of the method as expressed by feminists and by Wynne (1992b) for example, may be ameliorated.

Having stated my position on paradigmatic questions, the choice of mixed methodology in the end was a relatively pragmatic one with the aim of gaining from the different strengths of the two methods. Put briefly, in-depth interviews are excellent at uncovering the perspective of the interviewee: the situation as it appears to them, in context. However in order to be able to go into depth, the sample size is inevitably small and therefore it can be problematic to extrapolate interpretations to beyond the research situation. Questionnaires on the other hand reach a larger sample size, though in less depth. The categorisation and standardisation of responses loses depth but allows comparability. With sufficient numbers, relationships between variables can be tested for statistically, with tests of significance applied.

In principle, the combination of the two techniques within the one study should enable both depth in context, and a broadening out into a larger sample. In particular, basing the questionnaire on the interview data maximises the extent to which the insights of the interviewees can be upheld and increases the scope of the questionnaire in this sense. The expansion into a larger sample through the questionnaire allows for the prevalence of particular beliefs or attitudes to be examined, and for relationships between variables to be tested. Whether or not causality is assumed is a matter for interpretation.

At the same time however I am attentive to the view of Sale *et al.* (2002) and Nightingale (2003) that the two methods should not be assumed to be looking at the same thing and so should not be expected to converge in the sense of traditional triangulation. It is not my intention, as it was Nightingale's, that the differences between the information gained from the two different methods should be the focus of interest. In my study, I feel that the two methods are rather closer in what they aim to uncover, and this is particularly so in basing the questionnaire on the interview data. I do feel though that it could be naïve to interpret the two data sets in the same fashion without an eye to the differences in the way that the two methods operate. The comparability or otherwise of the data from the two different data sets is therefore a point of interest in the research and interpretation process. Where differences occur this will need sensitive reflection in the light of the issues raised above.

3.2 SITUATING THE RESEARCH: GEOGRAPHICAL LOCATION

3.2.1 Selection of a borough

The research strategy was to take a case study of one London borough, and sample different clusters from within this. The primary reason for concentrating on one borough was for consistency in terms of the air pollution policy being implemented. Responsibility for local air quality and for implementing an action plan to fulfil the National Air Quality Strategy Guidelines lies at the local authority level. Different London boroughs take somewhat different approaches, for instance in either selecting target areas for management or declaring the whole borough an air quality management area (AQMA), and at the time of the research were also at different stages in the process of risk identification and management. It seemed reasonable to assume that this could be an influence in people's awareness, and, as I wanted to look at the influence of other factors including neighbourhood and social factors, it seemed better to concentrate on one borough.

In choosing a borough for study, the main criteria were:

i) that it should encompass areas with a range of air pollution levels;
ii) that the population should cover a range of socio-economic status brackets; and
iii) that the council should be interested in and supportive of the research.

Although I was not expecting financial assistance as such from the borough I wanted to be in a situation where I could approach them for appropriate information such as their pollution modelling and social data, and where they might be willing to provide other practical and logistical assistance if required.

Several boroughs were approached, one at a time, before finally the London Borough of Barnet was selected. The boroughs varied very much in their responses and willingness to co-operate. The first approach, in July 2000, was to Camden, where UCL is situated, and who have quite a high profile in London in terms of air quality management and support of public engagement. Camden have an officer dedicated to Air Quality Management and it was she who I approached. They however already had a PhD student involved with them and did not want to take on any more, although they were supportive of the project's ideas.

Kensington and Chelsea were the second borough to be approached, via their environmental health section, again in summer 2000. They expressed positive interest at the start, but over ensuing weeks it proved very difficult to get any information from them and they kept alluding to a difficult political situation. Eventually, I decided to go elsewhere, and contacted a third borough – Harrow. Initial contact was made through a planning officer known to my supervisor, who put me in touch with the relevant environmental health officers. The Harrow officers were very accessible and very interested in the research, and also had a student doing GIS mapping of pollution levels on a small scale which seemed potentially extremely useful. I also attended, in November 2000, a public meeting where Harrow's report on stage two of the Local Air Quality Management review and assessment was presented and discussed, and where views and questions from the public were heard. This was extremely interesting, and it was useful to hear some of the points and views expressed by the people attending. However on examination of their data, it turned out that the borough had very few, if any, areas where air quality could be described as particularly high, and also had a relatively small range on the socio-economic statistics (at ward level).

At this point I considered a study incorporating two boroughs and taking in the adjoining borough of Brent. This would provide a transect from central to outer London and a very good range of data; however after consideration I decided that two boroughs would involve too much fieldwork for one researcher to undertake adequately. In addition, Brent has very high poverty levels and high ethnicity and I felt this would raise issues in the research process which would require particular attention, and which I would not have the resources to address satisfactorily. These issues would include practical matters such as the need for translation and interpretation, and also matters which would need theoretical consideration such as how ethnic and cultural background might affect ideas about health and so perceptions of air quality and health.

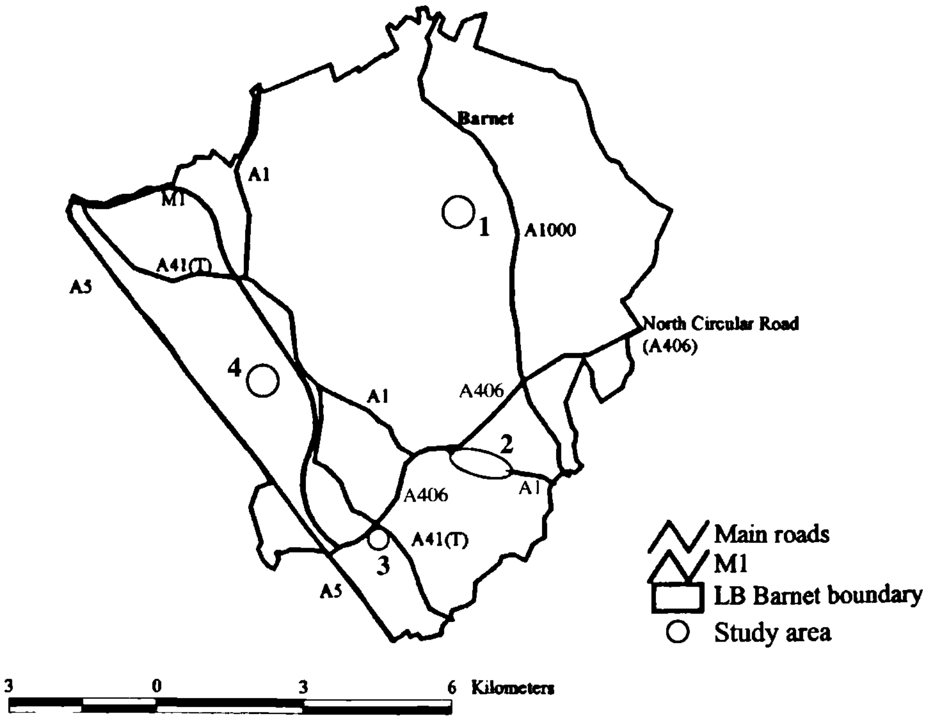
Whilst at Harrow's public meeting, I met and talked to the environmental health officers from Barnet who were responsible for air quality management. I made contact with them again in December 2000, and arranged a meeting in January 2001 where I also met the head of Barnet's public consultation department. They were all interested in the research proposal and willing to provide assistance in terms of data, contacts and in other matters such as possible provision of rooms for interviewing and so on. Barnet as a borough also had a convenient range of socio-economic categories and low ethnicity among its population, and a range of levels of air quality. It was therefore finally agreed that I should carry out the research in the London Borough of Barnet.

3.2.2 Barnet and its air quality management.

The London Borough of Barnet is one of the outer boroughs of north London (see map 3.1). It is an interesting borough in terms of studying air pollution in that through it run several of North London's major roads – the A406 (north circular), the A1, the M1 and the A41 (see map 3.2) and at the same time it has relatively quiet suburban areas, and large expanses of common land on which there is no building.

Map 3.1: Location of the London Borough of Barnet

Map 3.2: the London Borough of Barnet showing the location of the four study areas



The 1995 Environment Act and the 1997 National Air Quality Strategy require local authorities to undertake a process of review and assessment of local air quality, in up to three stages. Satisfaction of all criteria at any of the stages means that the later stages do not have to be undertaken. Stage 1 requires a broad brush review of the 8 listed pollutants and current sources within the borough, including identification of industrial point sources and existing or proposed roads with levels of traffic that could generate significant quantities of any of the key pollutants. Barnet's stage 1 report identified the M1, A406 (north circular), A5, A1, A41, A1000, A598 and A504 as roads which generate significant amounts of pollution, as well as 18 point sources including crematoria, a smelting works, garages and vehicle repair centres.

Barnet went on to produce a stage 2 assessment which was undertaken with the Urban Pollution Research Centre of Middlesex University (Crabbe and Beaumont 1998). This compiled an emissions inventory for the Borough; the dispersions of the emissions were then modelled to estimate current and future potential levels of air quality at specific locations. The stage 2 report showed that road transport was by far the largest source of key air pollutants, producing 84% of NOx, 91% of PM10, 87% of benzene, 96% of 1,3-butadiene, 99% of CO and 84% of SO2. Other sources were noted as imported pollution, point sources (industry), area sources (heating, construction dust, refuelling of vehicles) and rail traffic. Higher emission rates were shown to occur in the south part of the borough and along the major transport corridors.

Assessment at stage 2 predicted that exceedences of the annual mean NO2 and 24hr PM10 objectives would be likely along the major transport corridors by the end of 2005. It also predicted that some breeches of the 8hr running mean CO objective could occur.

Following this, for the Stage 3 report undertaken in 1999 (London Borough of Barnet 1999), Barnet employed environmental consultants South East Institute of Public Health (SEIPH) to carry out computer modelling of predicted levels of nitrogen dioxide NO2 and PM10 particles for 2004/5. This was done using data on traffic flows, on industrial sources and the worst case meteorological conditions. It was predicted that exceedences would occur for NO, NO2 and for PM10 along many of the borough's main roads. Maps were produced from the modelling procedure, showing the roads on which exceedences were predicted (see maps 3 3 and 3.4 – exceeding areas are shown in red).

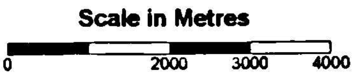
Map 3.3: Predictions of Exceedences of the Annual Mean NO2 AQS Objective for the London Borough of Barnet based on 1997 Meteorological Year

Image removed due to third party copyright

Source: London Borough of Barnet, 1999

Map 3.4: Predictions of Exceedences of the PM10 AQS Objective for the London Borough of Barnet for 2004 based on 1996 Meteorological Year

Image removed due to third party copyright



Source: London Borough of Barnet, 1999

Following public consultation on the stage 3 report and on various options, Barnet decided to declare the whole borough an Air Quality Management Area (AQMA). Part of the reason for this was to facilitate co-ordinated management, and to avoid creating planning blight in certain areas by singling them out for specific attention.

3.2.3 Selection of the study areas

The aim at the outset for stage one of the fieldwork, i.e. the qualitative interviews, was to select 4 neighbourhoods within the borough of Barnet which would respectively be characterised by:

i) high social deprivation and high levels of air pollution;
ii) high social deprivation and low levels of air pollution;
iii) low social deprivation and high levels of air pollution;
iv) low social deprivation and low levels of air pollution.

The initial assumption was that selection could be made using social deprivation statistics and air pollution mapping data. However, upon examination of these data, some conceptual problems arose.

Firstly, with respect to deprivation statistics. Indices of social deprivation were available from both the London Borough of Barnet and DETR (as it was) for each of the wards in the borough. However, after an initial exploration of parts of the borough it became clear that although these ward level statistics provided an indication of where some of the poorer and better off neighbourhoods tended to be clustered, they were at too large a scale to be a good reflection in practice of what on the ground was a much smaller scale variation in levels of socio-economic wellbeing. A further problem with the social statistics was that those accessible were calculated from the 1991 census, now rather out of date, introducing a further element of inaccuracy, were they to be used.

Secondly, with respect to air pollution data. The previous boroughs approached had had different strategies in the way that they approached the levels of assessment and hence produced different data, which took me a while to understand. For example, the London Borough of Harrow were in the process of producing a detailed GIS map of modelled levels of pollution throughout the borough which would be able to give a figure for NO2 and PM10 for any specified location. However, air pollution officers at other boroughs raised some questions about the usefulness of this approach, arguing that such mapping, although technically possible, was not particularly meaningful because it gave an impression of a level of accuracy that was not actually achievable. What several other boroughs chose to instead was to commission modelling and mapping which identified the areas of projected exceedence of the NAQS limits only.

In Barnet, the stage 2 report (Crabbe and Beaumont 1998) had produced maps of modelled emissions (which is not the same as ambient concentrations) for NO2, PM10, Benzene, 1,3- Butadiene, CO and SO2 from all sources, aggregated within 1km squares. This showed clearly where the highest emissions were concentrated but the problem of scale again applied – it would be highly inaccurate to the point of useless to take a point within any of the 1km squares and read the level of emissions as being that of the aggregate figure for the 1km square. Barnet's stage 3 report concentrated on NO2 and PM10 as the significant pollutants in the borough, and produced maps of predicted exceedences of the annual mean NO2 NAQS objective and the PM10 objective. From these maps it was clear that the zones of projected exceedence very closely followed the main arterial roads in the borough, including the A1 and A406 (north circular); the maps for the two pollutants were also almost identical in terms of where exceedences would occur – these two facts are not surprising given that the main source of each pollutant is road traffic. The zones of exceedence were also narrow, as pollutant concentrations fall away relatively sharply with distance from the road (London Borough of Barnet 1999).

From the above, it became clear that it was unrealistic to expect to be able to get accurate estimates of pollution levels at any particular point, and also, crucially, that relative pollution levels (in terms of NOx and PM10) would be best predicted by proximity to a busy road.

As well as the Barnet reports I also used the SIEPH OMNI website http://www.seiph.umds.ac.uk/omni/frames/omniframe.htm as a potential data source on air pollution levels; again this uses the SIEPH model for London, and the levels given by typing in a postcode are aggregated over 1km squares. However, from this website it was possible to access a list of roads in Barnet with modelled roadside annual average NO2 levels. I used this data, transposed onto a large scale map of Barnet, to draw up my own map of NO2 levels across the borough, relying on the fairly safe assumption that particulate levels would follow a similar pattern. This map was then used to decide where the most polluted areas would be. Given that pollutant levels fall away sharply as one moves away from the source, i.e. the road, I decided that in selecting houses that would fall within a zone of high pollutant levels I would need to follow a ribbon type pattern along the roads themselves. Although the SIEPH website gave levels for only a selection of roads, concentrating on the most polluted, my strategy in selecting areas of low pollution levels was that by default those further away from main roads and in areas of low traffic flow would fit this scenario.

The map that I produced to guide my study site selection therefore consisted of an enlarged scale road map with NO2 levels from the OMNI website transposed onto those sections of road for which they were available.

The next step in selecting the study areas was then to find areas which each formed a coherent cluster of housing that might be seen as a neighbourhood, and which together reflected the range of socio-economic status within the pollution categories of 'high' and 'low'. Due to issues with the scale of the available socio-economic data as outlined above, and the difficulty of defining a coherent neighbourhood from a map, my strategy was to explore the borough on the ground, making field notes about the characteristics of different areas. This enabled me to get a picture of relative socio-economic status at a smaller scale, and to get a sense of how coherent areas might be defined, which would not have been possible from using maps alone. For the reasons discussed above, this was a more practical and sensitive strategy than that of relying on available but perhaps rather meaningless statistical data. Sensitivity is an issue in that the socio-economic characteristics of areas can change rapidly over space, particularly in London, and ward level data for instance is not sensitive enough to reflect this. Socio-economic status at area level was therefore not measured quantitatively on a single scale, but data on the individual respondents to the questionnaire was collected, which testifies to the differences between the different areas (see Appendix 8).

The combination, then, of the pollution mapping from the SIEPH website, the assumption that pollution would be highest on busy roads and lowest where traffic flow was minimal, and the field notes from on-the-ground exploration enabled selection of the four study areas. Further issues in their selection were that each area needed to be of a feasible size in order to recruit sufficient people for interviews; and they needed to be accessible for me as a researcher relying heavily on public transport. It was not difficult to find suitable sites for the two 'low pollution' neighbourhoods, but it was harder to find 'high pollution' neighbourhoods of a suitable size and coherence, given that these needed to be sited on or close to a main road.

3.2.4 The Four Study Areas

The four study areas finally selected were as follows.

Totteridge study area – high socio-economic status, low pollution (study area 1 on map 3.2; map 3.5; images 3.1 and 3.2): a group of roads in Totteridge ward, close to Totteridge and Whetstone station, comprising the roads Ventnor Drive, Lynton Mead, Laurel Way and Coppice Walk. This area borders Totteridge Common on the east side, and there is access onto the common from the end of Laurel Way. Houses here were built in the 1930s and are typically semi-detached with 3-4 bedrooms, market value around £430,000-465,000 in September 2003. Most have extensive gardens at the back, and small gardens at the front. The roads are also tree-lined. Traffic flows are extremely light.

Modelled NO2 (background levels apply): 18 ppb (SIEPH).

Map 3.5: Totteridge Study Area

Image removed due to third party copyright

Images 3.1–3.2: Totteridge Study Area

Hampstead Garden Suburb study area - high socio-economic status, high pollution (area 2 on map 3.2; map 3.6; images 3.3 and 3.4). Hampstead Garden Suburb (Garden Suburb Ward) was a utopian housing project begun in 1907 by Lady Henrietta Barnet with the intention of creating a socially mixed neighbourhood. The housing in the suburb ranges from 7 bedroom mansions to 2 bedroom cottages. It is now a conservation area, overseen by a Trust, with strict regulations on maintenance. The Suburb as a whole is very wealthy and a pleasant environment, with many quiet, tree-lined roads. The study area was drawn up from those residences lining the A1, taking in Falloden Way, Lyttelton Way, the first residences of Eastholm, Midholm and Westholm closest to the A1, the part of Addison way adjoining the A1 and the part of Gloucester Drive facing the A1. The Falloden way houses are mostly two and three bedroom cottages, value around £250,000-300,000 in September 2003. 3 bedroom maisonettes on Lyttelton Way sell for around £375,000, and larger houses on the A1 end of Addison way and on Lyttelton road, for around £500,000. This compares to houses further away from the main road which fetch about £600,000 for a three bedroom house and £7-800,000 for 4-5 bedroom houses.

Falloden way cottages have small gardens front and back. Behind Falloden way on the south side is Northway Gardens which has tennis courts and though which runs Mutton Brook, and there is also access to Big Wood, a substantial area of ancient woodland. In Lyttelton Way the few larger houses have gardens and the lower flats and maisonettes have smaller ones. These are a little bit further set back from the road, behind grass verges but are not screened from the road at all.

The A1 has a constant flow of traffic including heavy goods vehicles and buses and it can be extremely difficult to cross the road. Along Lyttelton way the traffic is in 4 lanes; this reduces to two lanes at Falloden Way.

Modelled roadside NO2 (1997 conditions): 39.6 ppb on Falloden Way – 42 ppb on Lyttelton road (SIEPH).

Map 3.6: Hampstead Garden Suburb Study Area

Image removed due to third party copyright

Image 3.3: Hampstead Garden Suburb Study Area

Image 3.4: Hampstead Garden Suburb Study Area

Brent Cross study area - low socio-economic status, high pollution (area 3 on map 3.2; map 3.7; images 3.5. and 3.6). This area is part of a small council estate situated across the A406 (North Circular) from Brent Cross shopping centre. The study area took in three low rise blocks of flats - Anderson Court, Dyson Court and Rawlinson Court; the houses on Whitefield Avenue, and the three high rise blocks of flats – Clare Point, Norden Point and Whychcote Point. The high rise blocks were built in the fifties and the low rise a little earlier. Many residents are long term residents, some of the older ones having been there since the flats were built. Several of the flats have been bought from the council by the residents under the 'right to buy' scheme.

The low rise flats to the north side of the study area face straight onto the 4-6 lane A406, with the M1 junction very close on the west side, and the A406/A41 junction to the east side There is no screening from the road other than a high mesh fence. To the west of the estate is Claremont trading estate which until recently housed a waste disposal facility, and a railway line. To the south is an open area of recreation ground.

Modelled roadside NO2: 37.5 – 40.8ppb along the adjacent section of the A406 (SIEPH)

Map 3.7: Brent Cross Study Area

Image removed due to third party copyright

Images 3.5–3.6: Brent Cross Study Area

Grahame Park study area - low socio-economic status, low pollution (area 4 on map 3.4; map 3.8; images 3.7 and 3.8). Grahame Park is a very large council estate built in the 1960s / 70s and housing several thousand people. Most of the residences are flats, in blocks of varying sizes and up to 7 floors high. There are some houses and maisonette-style residences also. A few have been bought from the council but most of the flats have not.

The estate has a lot of social problems including drug use, unemployment, crime and deprivation. Recently asylum seekers and refugees are being housed there. The estate is due to be regenerated and plans have been drawn up involving the demolition of several larger blocks of flats and their replacement with more traditional style houses, and tree-lined roads.

Due to the size and design of the estate at present, there is relatively little through traffic, and to the west side there is a large area of green open space. To the east side of the estate runs the M1, but this is some distance away (approx 0.2 miles) and is screened. Recruitment for the study concentrated on the blocks of flats to the south of the estate.

Modelled NO2 (background levels apply): 23 ppb (SIEPH).

Map 3.8: Grahame Park Study Area

Image removed due to third party copyright

Images 3.7–3.8: Grahame Park Study Area

3.3 THE QUALITATIVE INTERVIEWS

3.3.1 The use of the semi-structured interview

The semi-structured interview is a means of collecting data that is designed to give rich insights into the experiences, meanings and beliefs of the interviewee, whilst maintaining a degree of comparability between respondents. The semi-structured interview is structured by means of a topic guide (schedule) but allows the researcher the flexibility to be open to each informant's way of talking about the topics and other topics relevant to him/her. The interviewer needs to be sensitive to the course of the interview and the style of the interviewee, and indeed "can and must decide during the course of the interview when and in which sequence to ask which questions" (Flick 1998:94). Prompts and probes can be used where necessary to elicit more information and these may be included on the schedule. The use of the same thematic topic guide across interviews allows comparison between respondents, but the aim is not strict standardisation.

It is important to recognise that an interview is a social encounter and not simply a passive means of gaining information (May 2001). Farr (1984) equates the 'inter-view' with the more inclusive methodology of participant observation, pointing out the researcher is both observer and participant. A conscious process of engagement necessarily takes place, not only to maximise the amount and usefulness of the information gained, but in order to establish rapport and to avoid treating the respondents in an exploitative manner (Oakley 1990). As such, researcher objectivity as a means of asserting the reliability or validity of the research is not sought for, but rather the role of the interviewer in shaping the encounter may be reflected on.

Similarly, the analysis of interview material is an interpretative process and one which will be idiosyncratic to the researcher, to a greater or lesser degree. As discussed earlier, it is my position that the same data set may support more than one possible explanation, but also that some explanations will be better than others, in that they will be closer to a reality which exists outside the research encounter. Interpretations however cannot make claims to objective truth, as the researcher as well as the subject of research is operating within networks of cultural meaning (Giorgi 1995), and so all accounts are subjective. Working from this viewpoint means that traditional reliability and validity criteria such as objectivity and replicability are not appropriate. Nevertheless, some accounts may be more persuasive, valuable or relevant than others (Madill *et al.* 2000). Potter (1996 cited in Madill *et al.* 2000) suggests that alternative quality criteria may be: internal coherence of interpretations, attention to deviant cases, and the openness of analysis to reader evaluation.

Deviant cases are likely to occur in topics such as that under study here and it is not the expectation of my interpretations to explain every individual's view but rather to give a description and interpretation of broad and general views and processes. Reader evaluation may be the bottom line criterion of interpretative research, and to this end it is good practice to give a clear explanation of how the research was carried out, and in presentation of results, to provide examples and evidence for arguments in the form of direct quotations from interviewees.

Reflection on the researcher's positionality is also desirable. I am female, white, university educated and was 32 years old at the time of the interviews taking place. I identified myself with the university in recruiting participants for the research, which gave a particular kind of identity, which was quite salient in some way in all the areas. In Totteridge and Hampstead, many people identified with it and mentioned their own time at university, or their children's' studies. In Brent Cross and Grahame Park people had less experience of academia and this tended to create something of a perceived class, or cultural, difference, but I also think this potential power differential was somewhat ameliorated by my being female and appearing quite young. The biggest potential influence I feel was a tendency for people to assume that I was performing the research out of personal concern over the issue, and they therefore could feel socially pressured to express concern themselves. However several people expressed little concern so I do not feel that this was an over-riding effect or that it was large enough to invalidate the research. Generally, over the course of the interviews, people tended to relax and become more expressive of their own thoughts and views.

As discussed earlier, it was the aim of my research design that the qualitative and quantitative stages should each be able to stand alone, but also that they should be able to combine to strengthen the overall study. Due to the differences in approaches, triangulation in the traditional sense of strict coincidence of results may not be possible, but my interpretation and presentation does use both data sets together in a way which should further strengthen interpretative arguments where possible.

3.3.2 Development of the interview schedule

The first step in creating the interview schedule was to list the topics and issues I wanted to cover. This was done first by brainstorming, and second by listing key points from the theoretical and empirical literature, which I wished to explore or take on board. General areas for questioning were organised into order, and I then addressed wording of questions.

One issue that took a lot of consideration was how to introduce and start the interview, as I was aware that how I chose to do this would frame and influence the ensuing discussion. One of the things I wanted to be able to consider was how salient the issue of air pollution was to people, so I did not want too direct an approach where I introduced the topic myself right at the start. On the other hand, most of what I wanted to know was specific enough to the issue that air quality would have to be put, and kept, on the agenda at some point. I also felt that interviewees would need, and had a right, to know roughly what the interview would be about when they agreed to do it.

After much consideration I decided to introduce the interview as being about 'healthy environments', and about how people thought their day-to-day environment might affect their health and well-being. This kept it within certain limits, but allowed me to see whether air pollution arose as an issue spontaneously. Having decided on this introduction, I chose to start the interview by asking people about where they live in a very general way, asking them how long they have lived there, and to describe the area, before moving on to whether they thought of it as a healthy environment, as a way of starting to focus in. From here on I decided to raise the issue of air quality, if it had not already been raised, or focus on it, if it had.

This choice of opening has various implications, particularly in that it framed at least the initial discussion in terms of the *local* living environment, whereas air pollution may not in fact be seen as a local issue. I was also framing the discussion in terms of health, especially by stating that this was broadly my area of interest. Other choices could have been made, but this seemed to be a reasonable way into the topic, and a way of keeping it within my areas of interest without framing the issues too tightly at the start. However I also felt that the interview was flexible enough that people were able to move beyond these initial framings if they did not relate to them.

The first draft interview schedule was piloted on 2 people, first a fellow PhD student with a different area of study, and secondly on one of the departmental computer support staff. Both pilots were taped and transcribed.

The first interview highlighted several shortcomings in my interviewing techniques of which I had been unaware at the time, particularly articulating questions badly, and interrupting. The second pilot was very short, which drew my attention to the fact that many questions were not open enough. The schedule would not work with people who had not thought much about air quality or did not think it was important. I also realised that the schedule was tending to elicit rather superficial responses, and I was not getting the depth of thought or expression that I was hoping for – I felt that I was not making the most of the method and that I was getting little more than I could from a very structured interview or survey.

After talking to a psychologist colleague and looking at some psychologists' interview transcripts, I developed a line of questioning with a more projective emphasis, such as 'when I say air pollution, what kinds of thoughts or images come into your head?'. These questions were noted on the schedule as prompts or alternatives for interviewees who had little to say about their own experience of air quality.

The schedule was then piloted twice more. The third pilot, with an administrator, elicited a lot of spontaneous talking, and made clear the value of getting people talking about their home and environment, and thoughts about their well-being, as it was during these monologues of talking about herself and her life that most of the interesting data emerged, and not necessarily in response to the more focused questions. The fourth and last pilot, with a younger male, also went well and I felt this was largely due to my improved technique, greater confidence and less direct way of questioning.

The final schedule (see appendix 2) was designed to be used flexibly: I realised that some people may have a lot to say about air quality, particularly if they felt they had health problems, and the more focussed line of questioning about their experiences and thoughts would work. The more projective questions were included to be used with people who had little to say about their own experiences of air quality, in order to get them talking around the issue and making associations, with the aim of eliciting something of their understanding and representations.

3.3.3 Recruitment for interviews

Recruitment was achieved by delivering letters to every address in sections of each study area. This letter outlined the project and asked for people to participate. One letter was sent to each residence, addressed to 'the householder'. In Totteridge and Hampstead letters were delivered by hand, for reasons of economy; in Brent Cross and Grahame Park letters were delivered by post as the residences were mainly flats and had security entrances to the buildings. People were offered £20 to be interviewed. I felt that the offer of money was necessary as an incentive in order to recruit more people and, crucially, in order to recruit people who were not necessarily motivated by the topic, and therefore to get a wider range of views.

In line with the approach taken in the interview schedule, the letter introduced the research as being about people's views on their local environment and how it affects their health and well-being. This was to give a necessary indication of the subject matter, whilst leaving room to explore within the interview whether the topic of air quality would arise spontaneously. It also set the scene for initial contextual discussion in the interview of how people felt about their neighbourhood in general and the kinds of problems, and qualities, they encountered there.

Two versions of the letter were written (see appendix 3); one was sent to Hampstead and Totteridge, and one to Grahame Park and Brent Cross. The latter was slightly more concise, and emphasised the payment at the top of the letter – I felt this was perhaps more likely to attract people in the lower socio-economic status areas, whilst the letter to the better-off areas put more emphasis on the participation in research. Both offered for £20 to be paid to charity as an alternative to giving it to the interviewee, in case an altruistic incentive would be more motivational to some. The letter asked people to phone me if they were willing to be interviewed or wanted to know more.

I aimed for approximately 8 interviews in each neighbourhood. It was not the intention in this part of the research to achieve a representative sample; however, a reasonable spread in terms of gender and age of interviewees was aimed for. It did not seem desirable to achieve a replica sample in all 4 neighbourhoods as the neighbourhood composition was different in each case. For example, there is a relatively high proportion of retired people in Totteridge. The sample was, to a large extent, a convenience sample as it depended on a relatively small response rate. However, my strategy was to accept people for interview until I felt there were too many of a certain group, e.g. retired people. I then kept others of this group in reserve and waited to see if it was possible to find respondents to cover more of a range of age and gender. In practice, there tended to be a bias towards females in all areas, but holding out for male respondents did achieve a reasonably balanced spread.

The neighbourhoods were targeted one at a time, Totteridge first as I felt this might be the easiest to recruit and interview in. Letters were delivered to two full roads: Ventnor Drive and Lynton Mead, and to the part of Laurel Way that runs between the two. This was a total of 228 houses. A total of 13 responses from people willing to take part were received. In Totteridge, 9 interviews took place, between July 10th and August 2nd 2001. Two of these interviews were with couples.

Next, letters were delivered in the Hampstead Garden Suburb area, to all houses and flats facing onto the A1 on Aylmer road (from the boundary of Barnet borough), Lyttelton Road, Falloden Way, Addison Way and Gloucester Drive, and also the first two houses closest to the A1 on each side of Eastholm, Midholm and Westholm – a total of 194 residences. 12 responses resulted in 8 interviews, carried out between August 15th and 24th 2001.

I went to the Brent Cross area third, and letters were initially sent to the low-rise blocks of flats which back onto the A406: Dyson Court, Anderson Court and Rawlinson Court – a total of 36 addresses. This elicited 5 responses all of whom were interviewed. Letters were then sent to the tower block closest to the A406 (Whychcote Point) and to houses between, on Whitefield Avenue – a further 60 addresses. Two responses overall were by snowballing, i.e. friends of people already interviewed, but also living in the same building. In total 8 interviews took place at the Brent Cross site, between September 26th 2001 and October 29th 2001.

Grahame Park, where I interviewed last, is a large council estate comprising many blocks of flats. Having visited the site, I targeted blocks at the south end of the estate nearest the tube station for ease of access, but also deselected some from their outward appearance as I felt unsafe going inside. My strategy here was to send out letters in batches until I had enough interviewees. Responses from Grahame Park were more difficult to deal with: two or three people called with questions mostly unconnected with the research and were referred to the council or appropriate body. Two were politely turned down as their English was too poor. In total 210 letters were sent out which led to 7 interviews; one further interview took place with a friend of one of the first respondents, making a total of 8. This last person lived at the north end of the estate. Interviews took place between October 31st and November 16th 2001.

3.3.4 The interviewees

The final interviewees in each study area were as follows. Pseudonyms have been used in all cases. The personal information beyond gender and approximate age was not collected explicitly but is taken from what emerged in the interviews, hence is not equivalent for all participants.

Totteridge Study Area

Interview 1.1: Kate. Female, 40s, married, 11yr old daughter, primary school teacher. 2 car family.

Interview 1.2: Claire. Female, 40s, divorced, 2 children in late teens, teaches English to foreign adults. Car driver.

Interview 1.3: Phil and Maria. Couple, early 50s, teenage children. Maria works, Phil is probably on extended sick leave or retirement, due to heart problems. At least 2 car family.

Interview 1.4: Denise. Female, married, early 40s, children at university. At least 2 car family.

Interview 1.5: Mrs Coates. Female, approx aged 70, retired teacher, married, drives.

Interview 1.6: Paul. Male, early 40s. Stocks and shares trader, own business, 2 young children. Drives.

Interview 1.7: Richard and Jean. Couple, approx aged 70, retired, 1 car.

Interview 1.8: Gianni. Male, late 30s, single, works in a casino. Drives and cycles.

Interview 1.9: Mrs Chan. Female, 40s, Chinese Malaysian origin, married, one son at university, one son aged 16. Does not work. 1 car family.

Hampstead Garden Suburb Study Area

Interview 2.1: Mrs Kapoor. Female, 60s, married, Indian origin. Interpreter, 2 adult daughters.

Interview 2.2: Mr Farnham. Male, late 40s, married, small child. works as a printer, drives.

Interview 2.3: Erica. Female, late 60s, widowed, grown up children, retired teacher, drives.

Interview 2.4: Karen. Female, 36, lives with partner, young daughter, drives.

Interview 2.5: Omar and Viviane. Omar - Male, 60s, married, Middle Eastern origin. Does some work for local councils, probably language based. Viviane his wife, participated for short part of the interview.

Interview 2.6: Elaine. Female, 50s, teenaged son, drives.

Interview 2.7: Len. Male, retired, president or similar of residents association, rides motorbike.

Interview 2.8: Siobhan. Female, 30s, single, fairly recently moved from Ireland.

Brent Cross Study Area

Interview 3.1: Pauline. Female, late 60s, retired, lives alone, smokes, does not drive.

Interview 3.2: Janet. Female, 30s, single mother, young children, black. Not working, does not drive.

Interview 3.3: Norman. Male, aged 93, widower, retired. Treasurer of Residents' Association. Does not drive.

Interview 3.4: Nigel. Male, approx aged 40, single, has car washing business, low income. Smokes, drives.

Interview 3.5: Mrs Moss. Female, 83 years old, widowed, adult son, smokes, does not drive.

Interview 3.6: Pam. Female, 60s, has been single mother, secretary to MP, drives.

Interview 3.7: Julie. Female, approx aged 50, married, grown up children. Drives.

Grahame Park Study Area

Interview 4.1: Dan. Male, approx aged 30, single, African origin, no children, lives in shared house. Does not drive.

Interview 4.2: Caroline. Female, 30s, single mother, not working, son 2-3 yrs, she is asthmatic, does not drive.

Interview 4.3: Mrs Sharma. Female, 60, married, Asian Kenyan origin, lived adult life in UK. Adult children. Drives.

Interview 4.4: Mr Walton. Male, 60s, retired, lives alone. Appeared to have mental health problems, probably delusional. Does not drive.

Interview 4.5: Sally. Female, late 30s, single mother, children aged 12 and 19, slightly asthmatic, ex smoker, does not drive at present.

Interview 4.6: Mr Robson. Male, aged 57, not working, lives alone, ex smoker, possible alcoholic. Does not drive.

Interview 4.7: Suzanne and Jason. Couple, early 20s, Suzanne has one four yr old child and one six months old, younger child has breathing difficulties. Jason is also asthmatic. Do not drive.

Interview 4.8: Michelle. Female, 30s, single mother, children about 16 and 10, does not work, smokes, does not drive.

3.3.5 Conducting the interviews

Interviews were mainly conducted in people's homes. This was felt to be appropriate as the interview was about where people lived and was far better taking place in context, so if not in their home then somewhere nearby was desirable. One of the interviews for the Brent Cross area took place at Hendon library, at the request of the respondent. As a safety procedure for all interviews, a check-in and check-out system by phone was in place, and for all interviews with men I was accompanied by someone else. Usually the accompanying person did not participate but occasionally they were drawn into the conversation for short periods.

Some of the interviews took place with couples. The couple interviews happened as such because this was the way the respondents presented themselves when I went to interview; I did not feel that this compromised the interviews, as they were informal, and involved exploration of ideas, and because within these couples such ideas and opinion forming clearly took place partly through mutual discussion. It did not mean that both people agreed either – sometimes the two people in the couple had separate ideas which they were quite capable of expressing as such.

The interviewing process was rather more challenging at Grahame Park than in the other 3 areas. I felt less safe there, and there had recently been a murder of a teenage boy on that side of the estate. This had affected the general morale and was discussed quite a lot in the interviews. Two interviewees were particularly difficult: one was drinking alcohol throughout the interview; the other was almost certainly delusional. In terms of the data produced, I decided that the former was worth using as the interview was coherent and the respondent's views were valid as a member of that community. The latter was more problematic and the interview was cut short; I used only parts relating to how he felt about the neighbourhood and living there, as again these were coherent and, I felt, valid as the personal views of a resident.

All interviews were taped on a portable dictaphone. Interviewees were asked for their permission to record before the start of the interview and gave verbal consent. At the start of the interview, the purpose of the research was resummarised to them in general terms similar to those given in the letter, and the interviewee was given a chance to ask questions or voice any concerns. I also re-stressed that it was intended to be informal, that I was interested in their thoughts, opinions and experiences and that there were no right answers. If the individual did not find a question relevant or was uncomfortable with anything I asked that they should say so and we could move on – although I would not intentionally be asking anything too personal. I assured anonymity and explained to them what would happen to the data.

Interviews lasted between 40 minutes and 90 minutes with the majority lasting about an hour. At the end, interviewees were given a chance to ask any more questions or to add anything. They were then paid £20 in cash and signed a receipt.

3.3.6 Analysis of the interviews

All interviews I transcribed verbatim into Word. Unfortunately, two of the interviews from Brent Cross were inaudible due to problems with the cassette player and microphone configuration. Notes were made from memory on both of these as soon as the error was noticed, which was immediately after the second interview.

I used Atlas Ti qualitative analysis package to aid in the analysis of the interview data[7]. Atlas is designed around grounded theory (Glaser and Strauss 1967) and allows grouping of sections of the interview transcripts, from single words to paragraphs or more, into 'codes'. Codes can then be organised into families or networks, aiming for facilitation of theory building. Quotations and codes, families and documents can be annotated with notes as the analysis progresses. Quotations can be put into more than one code. Most useful is the retrieval function which allows sections of text to be retrieved easily by code; for instance if the code 'local air' had been used, sections of text from any of the documents (interview transcripts) in that file which had been placed under this code could be retrieved and viewed together.

The way that I used Atlas Ti was mostly as a data organisation tool, to make use of the coding facility and the ability to retrieve quotations grouped by code from several transcripts at once. I made some electronic annotated notes also. I did not however use the programme to organise codes into families or build networks; this more conceptual

[7] Other packages for qualitative analysis are available, most popularly NUD*IST. I used Atlas in preference as I found NUD*IST rather more complicated to use, and also that it enforced a more hierarchical structure on the coding frame which was not necessarily appropriate. I felt that Atlas's non-hierarchical approach was more flexible as codes could easily be conceptually grouped together if I so wished, without the package needing to do this explicitly.

level of work I did myself using my own notebook as it was more flexible and easier. There is no doubt though that using the package in the way that I did helped enormously in the analysis. The package also allowed easy movement between the quotations grouped by code and the quotation in the context of the transcript – this is important is it is necessary to move back and forwards from codes to transcripts in theory building, to be able to view quotations both separately and in context.

The coding frame that I used was developed partly *a priori* but largely by going through the first transcripts. The approach was thus partly that of 'grounded theory'; I did not follow the full grounded theory procedure (Pidgeon and Henwood 1996) in that I did not code every part of initial transcripts into axial codes and so on, but the coding frame and resultant theory were nevertheless grounded in that they were built largely out of the data. I did necessarily have *a priori* questions and areas of interest due to the nature of my questions and the theory on which the interview schedule had been built. Some codes were therefore directly linked to the questions asked in the interviews, for instance how people would rate their local air quality. However information pertaining to these codes was to be found throughout the interviews and not just in direct response to the particular questions – hence the need for thorough coding and the ability to abstract quotations into codes rather than just look at responses to questions. Other codes were more thematic or related to more abstract constructs. A list of the codes used in analysis is given in appendix 4.

The interview analysis was written up thematically as an initial stage of the research. The interviews had yielded a large amount of very valuable data. In particular they allowed a lot of insight into how people formed perceptions of air quality and the reasoning and thought processes behind their views and concerns about the effects of air pollution. The interviews were particularly good for getting to the contexts and contingencies of these thoughts and beliefs. This output from the qualitative research stage was valid on its own as a piece of research. The main themes of interest were pursued and developed in the questionnaire and the subsequent analysis of both which is presented in this thesis, but the interview analysis in fact contained much additional material.

3.4 THE QUESTIONNAIRE SURVEY

3.4.1 The use of questionnaires

As discussed above, questionnaires are essentially a quantitative research technique with roots in positivism, empiricism and a natural science model of how research should be conducted. The aim is standardisation of tests for strict comparability, minimisation of subjectivity through distancing the researcher and through the use of standardised statistical tests in analysis, and reliability and validity achieved through replicability and through such maximisation of objectivity.

Questionnaires as a research tool have been criticised for pretending to produce direct and value-free knowledge whilst in fact actively constituting knowledge and meaning (e.g. Hacking 1990, cited in Tonkiss 1998). Such criticisms of blind and naïve empiricism however may underplay the role of theory in structuring observations which are made through the use of surveys (Tonkiss 1998). Similarly, the role of theory and researcher subjectivity in the construction of the categories which frame the way in which the knowledge can be produced can be seen more explicitly. It is my assertion that a recognition that the construction of questionnaires and the use of statistical procedures actively help construct the knowledge that is produced makes their use more reasonable within an epistemological position such as I outlined above, and less incompatible with the use of interpretative techniques such as semi-structured interviews. I am not claiming neutrality or objectivity in my questionnaire survey; just as with the interviews, the way that this part of the research proceeded and the interpretation of results was coloured by my involvement and by choices I made. What is produced is a selective model of some reality which I do believe exists beyond the research. How good a model it is, i.e. its validity, must be judged in the light of procedural integrity and transparency, sensitivity of interpretation, and plausibility of results in the light of other research in the field.

In this case the grounding of the questionnaire in the interview data and the use of categories which came as far as possible from the interviewees themselves also help to counter some of the criticisms which have been levelled by researchers who generally favour a qualitative approach. In this way the imposition of meanings on those being researched is minimised. In using the questionnaire to extend insights from the interviews I hoped to benefit from the advantages of questionnaires, in reaching a larger number of people and in being able to make comparisons and look for associations, with frames of reference as to the reliability of assertions made. Such a frame of reference is provided by the use of standard statistical procedures and by tests of significance, but again I recognise that these are constructs and agreed protocols and their usefulness is in their being nothing more nor less than this.

3.4.2 The questionnaire

The aim of this second stage of data collection was to expand the sample size, enable comparisons between views from different areas with statistical tests of significance, and to look for relationships between views expressed and other variables. Due to necessary limitations of sample size and sampling procedure, the survey did not aim to make claims of representativeness for the borough of Barnet, nor indeed to be strictly representative within each of the areas.

The questionnaire (see appendix 5) was very much grounded in the data from the analysis of the interviews. The questionnaire was divided into 7 sections covering:

i) views on the neighbourhood;
ii) views on air quality;
iii) the effects of air quality;
iv) management issues;
v) knowledge and information;
vi) particular attitudes; and
vii) personal information.

These categories were decided from the main themes and areas of discussion that had come out of the interviews. Within each category, specific questions were then chosen through further examination of interview data, and through deciding which lines of interest to pursue, considering as well the overall research questions and theoretical interests.

Inevitably, the overall questionnaire length was a limiting factor in its design. Many questions had to be discarded on order to keep the length feasible. One result of this was that some constructs were measured by one question only, where several questions would have provided a better measure – for example question 1 measuring satisfaction with the neighbourhood provides a single simple measure, where a better measure could have been made from a few questions measuring various aspects of neighbourhood satisfaction. However the final format was the result of a judgement regarding trade-offs between quality and covering all areas of interests, likely response rates given the length, and printing and postage costs.

3.4.3 Question design

The questionnaire was designed for self-completion, and this had a bearing on the wording and formatting of the questions: they had to be clear, uncomplicated in language, and in a format which would be easy to follow throughout the questionnaire. The way in which answers should be marked had also to be explained clearly. In designing the question format, one consideration was to have as many answers as possible in the form of interval/ratio data, rather than categorical data, as this would enable more advanced analyses such as multiple regression to be performed should this be appropriate later. Particular use was made of the Likert-type scale. Questions designed in this manner typically give a statement, and then a series of categories on which the respondent can answer, indicating degrees of agreement or disagreement with the statement. A slight variation on this was used in for example question 2, where a list of possible problems in the neighbourhood was given, and the respondent was asked to indicate how much of a problem they thought each was in their neighbourhood. Most of the answer scales were unipolar such as those in question 2 which ranged from 'not a problem at all' to 'a very big problem'; some were bipolar, for example the attitudes in question 31, which ranged from 'disagree strongly' to 'agree strongly' with a neutral middle point. For both types a five point scale was deemed a sufficient degree of gradation in most cases. For a few questions, particularly those where I asked for rating of air quality (questions 3 and 4) I decided on a 7 point scale for more sensitivity.

These scales are essentially ordinal measures, but the data is typically treated as interval / ratio (Nardi 2003; de Vaus 1996), which makes the assumption that the intervals between the proffered categories are conceptually equal – for example that the difference between 'occasionally' and 'sometimes' is the same 'distance' as the difference between 'sometimes' and 'often' (Question 21). In order to lessen the degree to which this assumption might be questionable, the answer scales were offered as numbers with the worded categories printed above, which made them appear more as continuous scales than ordinal categories. The combination of words and numbers was also designed to facilitate answering for as many people as possible, as through question testing I found that some people paid more attention to the numbers, while others related better to the worded categories.

For some questions a scalar answer was not possible and so categories were offered: this applied mainly to those where a 'yes' 'no' or 'don't know' response was needed, and also to certain questions in the personal information which would be used as explanatory variables in analyses.

Other questions were open-ended, allowing the respondent to write their own response without fitting it to given categories (e.g. questions 11b, 12b, 13b). In these cases this choice was made as I felt that offering categories would give too much prompting of possible answers and I wanted answers to come from the respondents themselves. In most of these questions answers were coded post hoc into nominal categories which were drawn up from the range of responses given. Often responses in more than one category were given in these questions, in which case more than one response was recorded.

All questions were worded as simply as possible without losing the specific meaning. Draft questions were tested on several respondents and modified where necessary before being included in the final version, to make sure that the received meaning corresponded as much as possible to the intended meaning.

3.4.4 The Questionnaire sections

Section 1, 'Where you live' was designed to elicit contextual information about how people felt about their neighbourhood in general. Question 1 dealt with overall satisfaction, offering a 7 point bipolar scale for response. Question 2 gave a list of possible problems people might encounter and asked for an indication of how much of a problem each was felt to be. The list was compiled from problems raised in the qualitative interviews, and a space given for respondents to add their own. The intention was also that later analysis could look for factors or clusters in these problems.

Section 2 consisted of questions about air quality and its causes. Respondents were asked to rate both their local air quality and air quality in central London on a 7 point bipolar scale, enabling comparison (questions 3 and 4). In questions 5 and 6, a list of possible causes of air pollution was given and respondents asked to rate how much each caused air pollution both locally and in Central London. Again the list of possible causes was taken from explanations offered in the interviews, without a judgement being made as to how 'correct' they were. 'Don't know' categories were given in these questions to avoid people being pressed into giving meaningless answers.

Section 3 asked questions on the effects or air quality, concentrating on the health effects. In the interviews (and indeed in the scientific literature) issues of whether air pollution could induce the onset of certain conditions, as opposed to exacerbating existing conditions, had been quite important. In order to address this, two separate questions were asked. Question 7 attempted to address explicitly issues of causality, whilst question 8 dealt with exacerbation. In order to elicit people's 'lay' opinion as much as possible it was emphasised that the question was not designed to be a test of how much they knew and as such there was no right or wrong answer. The questions were also worded carefully, that the illnesses had been 'suggested' by 'some people' as being connected with air pollution. The list of suggested illnesses was taken from the interviews, with space for additions to be made. A 'don't know' category was provided so that people were not forced into answering when they felt they could not offer an opinion on the matter; this was also designed to give some measure of levels of uncertainty.

Questions 9 and 10 measured perceived importance of air quality for health both personally and generally. Questions 11, 12 and 13 asked whether people felt their own or close others' health had been affected by air pollution, and if so, specifically how. This latter part did not offer categories, to avoid too much prompting. Respondents were also asked about any other (non-health) effects (question 14), and asked to indicate how often they undertook any actions due to poor air quality (question 15). This list of possible actions was taken from the interviews.

Section 4 addressed air quality management options, and issues of responsibility and trust. People were asked to rate the appropriateness of a series of options as a way of controlling air pollution – the options were based on ideas offered by the interviewees. Questions 17 and 18 related to the degree of responsibility for air quality accorded to various organisations and the degree of trust felt in each of these organisations with respect to hypothetical air quality management. Again the list of organisations was informed by the interviews. 'Don't know' options were given in this section, as people might be unfamiliar with organisations or not feel able to give an opinion on policy options.

Section 5 asked questions relating to how and where people gained knowledge about air quality. Questions 20a and b related to how much, and how, they used their own judgement. Question 21 asked how much they used various sources of information: media sources were listed but the category 'own knowledge/experience' was included for comparison. This question also related more to immediate situations rather than air quality or pollution as a general issue, which was covered more by question 19. This section also covered confidence in the level of their own knowledge, expert knowledge and public knowledge. Question 25 addressed levels of trust in various sources of information, some of which came out of the interviews. Respondents were asked if they wanted more information and in what format. There were then some questions relating to local air quality management: they were asked about what level of involvement they thought the public should have in making decisions about air quality policy; after a short explanation of the local air quality strategy they were asked if they had heard of it; lastly questions 29 and 30 related to their enthusiasm and optimism regarding such a strategy.

Section 6 was a series of attitude statements with Likert scales for responses. These were taken from statements made in the interviews, as close as possible to the kind of wording used by the interviewees. The questions were designed to cover levels of concern, the perceived scale of the problem, and fatalism/control. Some of the statements were expected to cluster together in terms of response patterns, for instance 'most people are too busy to worry about air pollution' and 'I don't worry about air pollution because I can't do anything about it' but this would be an issue for analysis. In particular, in terms of scale, I was interested in whether seeing air pollution as a problem locally, nationally and globally would go together or whether these would be separate issues.

Section 7, the final section, asked questions about the respondent. The usual categories of gender, age, income and employment were elicited; both occupation and ethnicity were left to be self-described rather than giving lengthy category lists: this was felt to be adequate and appropriate given that the sample size would be relatively small and probably not cover many categories. In addition people were asked about media consumption, whether or not they had children under 16, means of transport, car ownership, length of time lived in the neighbourhood, and whether or not they suffered from particular health conditions – as all these have been suggested as affecting risk perceptions relating to air pollution.

At the end of the questionnaire extra space was provided for the respondent to add any information or make comments.

3.4.5 Questionnaire testing and finalisation

The draft version of the questionnaire was tested on 15 volunteers from a range of backgrounds. The testers were asked to talk through their thought processes as they read and answered the questions. In this way their understanding of the questions and their reactions to the format were elicited as well as any difficulties in answering any of the questions. This process lead to a re-wording of several questions and some changes in the layout of the scales. Preferred fonts and letter sizing were also decided on. The time taken to complete the questionnaire and reactions to its length were noted.

After the questionnaire pilot described below, I noticed that several people had omitted to answer the first question, and so the format of the first page was altered to leave a larger space above the first question so that it appeared more obvious. Other than this no changes seemed necessary after the pilot and so the questionnaire remained in the same form.

3.4.6 The survey sampling

The aim of the survey was to widen the number of people reached in the research and to provide data in which relationships between variables could be tested. In order to be able to perform analyses and show significant relationships it was felt that a minimum of 50 returned surveys from each area should be aimed for. A return rate of 15-30% to a postal survey was expected, on sending of the questionnaire plus a reminder[8].

Due to the geographical size of the study areas and the relatively low number of returns expected, the strategy I decided on was to send questionnaires to all adults on the electoral register, up to a number where an appropriate number of returns would be reached. This was expected to require sending out approximately 250 questionnaires in

[8] This figure for return rates was established through personal consultation with experienced survey researchers at the Methodology Institute, London School of Economics.

each area. In the smaller areas of Brent Cross and Hampstead Garden Suburb this would mean most or all residents in the study area would be covered; in Totteridge and Grahame Park a portion of the neighbourhood would be covered. In covering all adults in particular areas this sampling strategy is representative of that specific area. However a low return rate would mean that the actual sample achieved would more resemble a convenience sample. Thus the data resulting could not be taken as strictly representative but relationships in the data could nevertheless be valid. The names and addresses of adults on the electoral register in each area were obtained at Golders Green library and entered into an excel spreadsheet.

3.4.7 Administration of the survey

The survey was administered postally, for self completion and postal return. This method was chosen in preference to a door-to-door calling strategy, first for reasons of safety, and second for time efficiency, although a postal survey does generally result in a lower return rate (De Vaus 1996). A Business Reply Service account was set up so that addressed, postage-paid printed envelopes could be provided for return of the questionnaires. In this way only the postage on the returned surveys needed to be paid for. In addition, costs were minimised by hand-delivering the questionnaires where possible. As an incentive, entry to a £100 prize draw was offered to all those who completed the questionnaire and space was left on the back of the questionnaire for people to leave a name and contact phone number or address.

The questionnaire was delivered in an envelope along with the reply-paid envelope, a covering letter, and an extra sheet with some extra brief instructions. The covering letter (appendix 6) briefly explained the purpose of the research, stressed that answers would be confidential and that there were not any right or wrong answers as it was people's point of view I was interested in. It also explained the prize draw incentive. Each letter had the individual's name inserted by mail merge. The extra brief instructions (also in appendix 6) again stressed confidentiality and that there were no right or wrong answers, assured people they should not think too long or hard about their answers and also assured them they could leave answers blank if they wished.

Each questionnaire was addressed to the individual by name. In Totteridge and Hampstead Garden Suburb they were delivered by hand; in Brent Cross and Grahame Park they were again put through the postal system as most addresses were flats with security entrances.

The questionnaire was first piloted to 50 addresses in each of the four study areas to test response rates and check for any problems in responses. This took place in July 2002. Within 3 weeks the numbers of returns were as follows:

Table 3.1: return rates for the pilot survey in the four study areas

Study area	No. sent	No. returned	% return rate
Totteridge	50	8	16%
Hampstead GS	50	18	36%
Brent Cross	50	7	14%
Grahame Park	50	13	26%
TOTAL	**200**	**46**	**23%**

This was felt to be a reasonably good return rate given the length of the questionnaire and its being sent in a blanket rather than targeted manner. The relatively low return rate in Brent Cross was a little concerning, as this was the smallest area with a limited population to whom it could be sent. Nevertheless I decided to proceed, with the only change being made to the format of the first page as noted above. As no changes were made to any question formats between the pilot and the main survey, the data from the pilot was included in the final data set for analysis.

The main survey was sent out between August and December 2002. Each sent questionnaire was recorded in a spreadsheet; returns were then recorded and after two to three weeks a reminder was sent if no answer had been received (see appendix 7). Initial response rates were not as high as the pilot, and so the number of questionnaires sent out expanded considerably beyond the initial plan of 1000. In particular, more had to be sent to Grahame Park in order to achieve the desired number of returns, although it transpired later that this was partly due to a problem with the Business Reply Service, and returned questionnaires being extremely delayed in the postal system. In Grahame Park I also abandoned the use of the reminder letter, as this achieved negligible extra returns for the cost, and instead sent out questionnaires to new addresses.

The number of returns was again low in Brent Cross and the area could not be expanded. Part of this seemed to be due to many of the names registered on the electoral register being no longer resident. In addition to the reminder letter being sent, in Brent Cross I also wrote to the chairperson of the residents association and phoned one of the previous interviewees who had shown enthusiasm, and asked both of them to give any encouragement they could to people to fill in the questionnaire.

The total numbers of questionnaires sent and returns received were as follows:

Table 3.2: return rates for the full survey in the four study areas

Study area	No. sent	No. returned	% return rate
Totteridge	300	54	18%
Hampstead GS	298	55	18.46%
Brent Cross	290	36	12.41%
Grahame Park	700	55	7.86%
TOTAL	**1588**	**200**	**12.6%**

This return rate was disappointingly low compared to the pilot, but as discussed, partly lowered by reliance on the electoral register which turned out to have a number of non-residents still registered, and also by problems with returns being sent through the reply service account[9]. The relatively high response rate in Grahame Park in the pilot was in retrospect probably due to a high proportion of retired people living in the blocks to which the pilot survey happened to have been sent. In the main send-out, the survey

[9] Six additional completed questionnaires were received from Grahame Park two months later, having been held up in the business reply system, but were too late to be included in the analysis. These bring the response rate in Grahame Park up to 8.7% and the total response rate up to 13%.

reached a more mixed population including a higher proportion of people with a first language other than English than in the other areas. The number of returns from Brent Cross in particular was lower than ideal, a point which needs to be taken into account in analysis, as it is more difficult to detect significant effects in a small sample.

The social and demographic characteristics of the respondents for the 4 separate study areas and for the whole achieved survey sample are given in appendix 8.

3.4.8 Analysis of the survey data

A coding sheet was compiled giving a system of numerical coding for each question. For questions where responses were numerical such as those with Likert-type scales the coding value was the same as the face value; for other questions with categorical or open responses, numerical values were assigned to each category. All responses were then entered into an SPSS spreadsheet. Missing responses were assigned a standard code, as were 'don't know' responses. For some questions, recoding of answers into new variables and constructs took place as analysis proceeded, for instance where one or more categories was small. This was done using the 'Transform → recode' function in SPSS.

On the initial conceptualisation of this study, it was the aim to use multi-level modelling techniques (see e.g. Goldstein 1995, Leyland and Goldstein 2001) in the quantitative analysis as the most rigorous way of separating compositional and contextual effects, i.e. separating out the effects of variables to do with the area, from effects to do with the individuals within each area. However, because of issues of measurement (see section 3.2.3) and issues of the structure of the data set, connected with the response rate, it was not possible to do this.

A multi-level model needs a minimum of roughly 20 units at level 2 (in this case area level). The 4 areas would not be enough, and so the original design had aimed to use enumeration districts as area units – for which there would be several within each study area. However, the low response rate meant that there would not be enough individuals within each enumeration district for the number of level 1 units to be sufficient in the model.

In addition to this, the issues raised in section 3.2.3 meant that the measurement of both s.e.s. and pollution level had been problematic and the aim of quantitative measurement of these for each e.d. had not been realised.

Thus the analysis made use of dummy (binary indicator) variables for each area within multiple regression models. This does not discriminate as well as does multi-level modelling between individual and area effects, as it basically models area at the level of individual, but it provides a basis for theorising about area effects, and is strengthened by being used in conjunction with theory and with the qualitative data set.

Analysis made use of the following statistical techniques, all performed within SPSS:

Analysis of variance (ANOVA). One-way analysis of variance tests the hypothesis that several means are equal. It is used to test an interval/ratio dependent variable against a categorical independent variable. For instance ANOVA could be used to test whether the mean rating of air quality on the scale given in question 3 (dependent variable) was different between the 4 different areas (independent variable). Where a significant difference between means was observed, post hoc tests were usually performed to diagnose which means were different. Tukey's honestly significant difference test was used here as standard; this assumes equal variances in the groups. Where the variances of the groups were significantly different, Tamhame's test was used. p values given are the probabilities that the differences between the means are due to chance.

Independent samples t-test. The independent samples t-test tests the hypothesis that two means are equivalent. It is used to test an interval/ratio dependent variable against a categorical independent (explanatory) variable, where the two categories in the explanatory variable are independent of each other. For example, this test could be used to test whether mean rating of air quality was different between people with asthma and people without asthma. p values given are the probability that the observed differences in means in the dependent variable are due to chance.

Cross-tabulation with Chi-Square statistic. Cross tabulations can be used to measure associations between two or more variables which are in the form of categories. For example area could be cross-tabulated against whether or not people think air pollution can cause asthma (question 7). The Pearson's Chi-Square statistic is used to test the hypothesis that the variables are not associated with each other; the statistic is compared against a chi-square distribution to calculate a probability value (p) which can be read as the probability that the observed association between the variables is due to chance.

Bivariate correlation. Pearson's correlation coefficient is a measure of linear association for two variables of interval/ratio form. It is not necessary to distinguish between dependent and independent variables. For example, one could test for an association between rating of local air quality (question 3) and happiness with the neighbourhood (question 1). The correlation coefficient gives an indication of the degree of association, +1.0 being a perfect positive association and –1.0 being a perfect negative association, with 0 as no association. The test of significance performed is two-tailed where the possible relationship could be either positive or negative. The p value given is the probability that the observed association is due to chance.

Linear regression. Linear regression estimates the coefficients for the linear equation involving one or more independent variables, that best predict the value of the dependent variable. This equation takes the form:

$$Y = a + b_1X_1 + b_2X_2 + e$$

where Y is the dependent variable, X_1 and X_2 are independent variables and b_1, b_2 etc are the coefficients. e is the error term. In simple linear regression there is only one independent variable in the equation. Multiple regression models the equation for several independent variables simultaneously. This can be read as modelling the effect of each independent variable on the dependent variable, controlling for the effect of the other independent variables. Each estimated regression coefficient is tested for significance and the p value given is the probability that the estimated effect is due to chance.

In linear regression, the dependent variable must be interval/ratio; the independent variables may be interval/ratio or categorical. For independent variables with more than one category, such as area (coded 1 to 4), a new set of variables is created, in this case with one area as the reference category and each of the others having a variable to itself which is a 'yes' or 'no'. Thus the effects of 3 of the areas are each modelled separately, and each taken as the effect of being in that area, as compared to the reference area.

The R^2 x 100 gives the percent of variance in the dependent variable explained by the regression: this is a test of the goodness of fit of the regression model. In multiple regression, the adjusted R^2 takes into account the number of independent variables relative to the number of observations. Multiple regression provides a model, and several models may be possible which give a similar fit of the data; thus other criteria will be needed to judge which model to select, such as theory or evidence from other data. Although it is possible to use regression in a 'data mining' way, ideally the model building process should be theoretically informed from the start, as the process by which the regression is built, in terms of which variables are entered and in what order, will affect the outcome.

Descriptive statistics. In addition to the analytical and modelling techniques above, means, frequencies, percentages and other descriptive statistics were computed in SPSS.

Criteria for statistical significance. The usual protocol is that a p value of 0.05 or below is taken as denoting statistical significance. A more rigorous test is a p value of 0.01 or below. These are read as the chances of the association or distribution in question being due to chance are equal to or less than 5% and 1% respectively. This however is a protocol, and significance is also to some extent a function of sample size (Mills *et al.* 1998). Due the relatively small number of returned surveys I received, especially from

Brent Cross, there are times when an observation with a p value of slightly above 0.05 may be worth consideration in my data as it may point to an effect which would fulfil standard significance criteria given a larger sample. Clearly this is a matter for interpretation and judgement.

In tests of significance, it is also important to note that a significant effect is not the same as a strong or important effect. A significant effect is one which is probably not a random observation; however, it may be small. The importance of such results is again a matter for judgement.

A key to the variable names for interpretation of the tables in the following empirical chapters is given in Appendix 9.

3.5 SUMMARY

In carrying out the field work for this study, I used a mixed methodology of qualitative and quantitative techniques. The aim behind this strategy was to achieve a depth of understanding of perceptions and the reasoning behind them, whilst widening the sample size and being able to look for relationships between perceptual patterns and other social and geographical variables. Justifications for mixed methodological strategies are often founded on a philosophical basis of pragmatism, particularly in policy contexts. Pragmatists' arguments however may sometimes hedge over important divergences and even incompatibilities in the techniques. It is important to consider that qualitative and quantitative techniques may not conceptualise the phenomenon under investigation in the same way and so may not be accessing the same thing. Thus triangulation in the traditional sense of using multiple techniques with the aim of achieving the same result may not be possible, although the aim in this research is that the two techniques should provide complementary data which is sufficiently compatible to broaden and strengthen the scope of the overall study. It is also important to recognise that both paradigms of research include framings and subjectivities.

The qualitative stage of fieldwork took place first and consisted of in-depth interviews. Analysis of these was conceived as a stage of research in its own right; it was also used to ground the questionnaire, which was the basis of the second stage of the research. It was felt that this maximised the sensitivity of the questionnaire with respect to the concerns of the public. The questionnaire was administered postally. The fieldwork took place in four study areas which were chosen to cover different levels of pollution and socio-economic status, to allow comparison in analysis. Data considerations emerged in the course of choosing study sites, with respect to the adequacy of both pollution data and socio-economic data. Personal knowledge of the area became an important input.

Analysis of the interview and survey data took place separately. Qualitative analysis was thematic and made use of Atlas Ti software. Analysis of the survey data used statistical techniques in SPSS. In the following chapters, results from both the interviews and survey are presented side by side, as they both aim to shed light on the relevant issues and questions.

CHAPTER 4

Perceptions Of Air Quality, Its Causes And Importance

In this chapter, I discuss data from both stages of fieldwork which relates to the research participants' understanding of their local air quality and air quality in London, and what the sources of air pollutants are. I also discuss how important an issue people felt air pollution to be, locally and in a wider sense. The role of contextual effects is of particular interest throughout.

4.1 PERCEPTIONS OF LOCAL AIR QUALITY

The most direct measure of perceived air quality was made in the questionnaire survey. Here, overall perception of local air quality was elicited by the question, "how good or bad do YOU feel the air is in the neighbourhood where you live?". Respondents answered by circling a discrete number on a seven point scale, where 1 corresponded to extremely bad and 7 to extremely good, with 4 as the neutral mid point (see Q3, appendix 5). They were also allowed to answer 'don't know'.

The mean rating overall was 3.80, (s.e. 0.098) which corresponded to just significantly worse than the neutral point of 'neither good nor bad'.
The means for each area were as follows:

- Totteridge 4.8 (s.e. 0.13) - roughly corresponding to quite good
- Hampstead Garden Suburb 3.22 (s.e. 0.18) - between neutral and quite bad, tending to quite bad
- Brent Cross 3.06 (s.e. 0.26) - quite bad
- Grahame Park 3.86 (s.e. 0.13) - between neutral and quite bad, but closer to neutral.

One-way analysis of variance of these 4 ratings showed some significant difference between them ($F = 21.720$, d.f. = 3, $p = 0.000$). However the variances of the 4 groups were not equal, so Tamhane's post hoc test was used to test which areas were significantly different from which others. This showed the following results:

Table 4.1: Differences in mean perceived local air quality between the 4 study areas

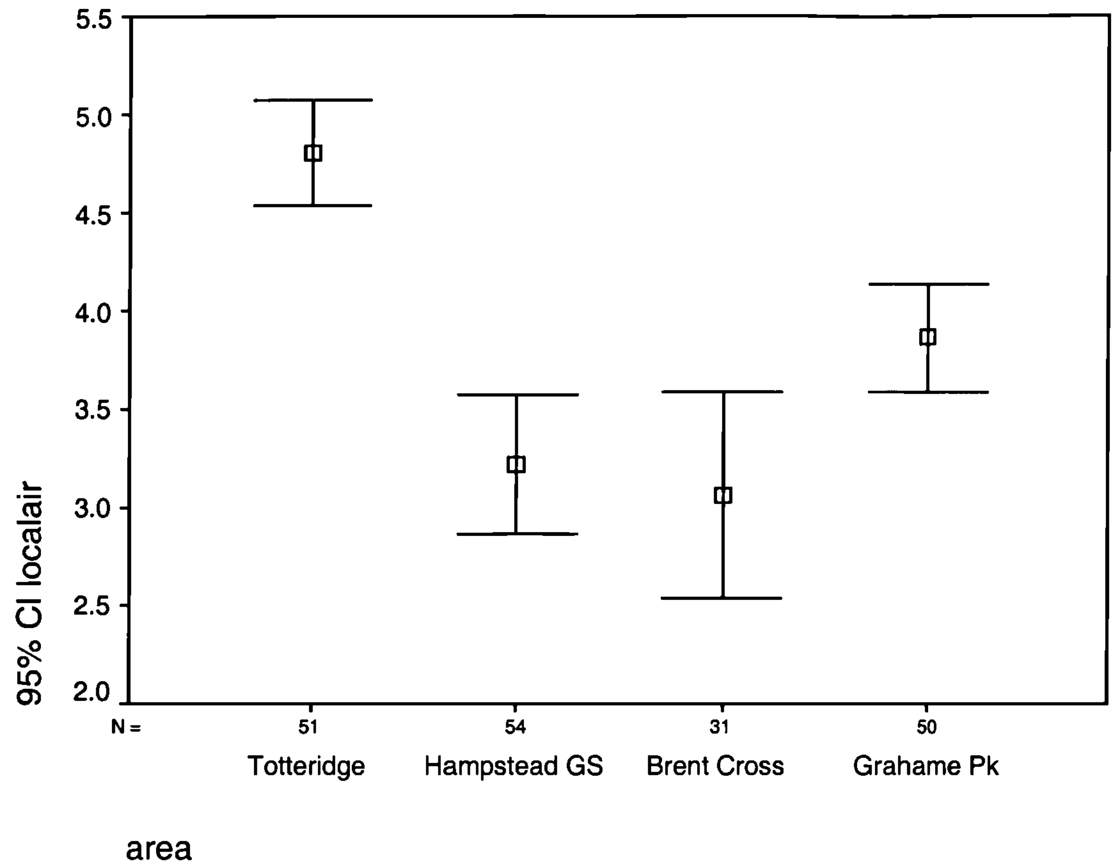
	(I) area	(J) area	Mean Difference (I-J)	Std. Error	Sig. (p)
Tamhane	Totteridge	Hampstead GS	1.58(*)	.222	.000
		Brent Cross	1.74(*)	.291	.000
		Grahame Pk	.94(*)	.190	.000
	Hampstead GS	Totteridge	-1.58(*)	.222	.000
		Brent Cross	.16	.313	.997
		Grahame Pk	-.64(*)	.222	.029
	Brent Cross	Totteridge	-1.74(*)	.291	.000
		Hampstead GS	-.16	.313	.997
		Grahame Pk	-.80	.291	.051
	Grahame Pk	Totteridge	-.94(*)	.190	.000
		Hampstead GS	.64(*)	.222	.029
		Brent Cross	.80	.291	.051

* The mean difference is significant at the .05 level.

The rating of air quality in Totteridge was shown to be significantly higher than in all other areas. Grahame Park was lower than Totteridge, and significantly higher than Hampstead but not quite significantly higher than Brent Cross. However it should be noted that Tamhane's test is in this case conservative in order to take into account the differences in variance, and so the difference between Grahame Park and Brent Cross is worth considering as of possible significance. The air quality ratings in Hampstead and Brent Cross were lower than in both Totteridge and Grahame Park but not significantly different from each other.

Similarly, this could be seen in plotting the means with 95% confidence interval error bars. Where the error bars do not overlap, the two means can be taken as significantly different at the 95% confidence level ($p=0.05$). The larger error bars around Brent Cross are related to the small sample size.

Figure 4.1: Mean ratings of air quality in the 4 study areas, with 95% confidence intervals



Comparing these ratings with the modelled levels of pollution shows a certain symmetry. At least on a relative basis, it seems that people's judgements of air quality correspond fairly well with the scientific data. In terms of modelled levels, Totteridge does indeed have the best air quality (18ppb NO2), followed by Grahame Park (23ppb NO2), and with Hampstead and Brent Cross both worse (39-42 ppb and 37-40 ppb NO2 respectively) – however confidence intervals are not available for these scientific estimates and so it is not possible to check the significance of any differences.

This broad correspondence of perceived air quality and measured, or modelled, air quality is in line with the findings of Arsdol, Sabagh and Alexander (1964), Thouez and Singh (1984), Zeidner and Schechter (1988), Bladan and Karan (1976) and Wall (1973). Such a finding suggests that people are responding to 'real' physical levels of pollution in the air. How people form their knowledge of ambient air quality is a point that I will address in chapter 6; however further exploration of influences on perceived air quality in both the quantitative and qualitative data highlighted some other considerations of interest apart from physical levels.

Analysis of variance showed relationships between perceived air quality and suffering from certain health conditions (ascertained by Q46). Asthma sufferers rated the air quality worse than did non- sufferers: mean 3.28 on the scale as opposed to 3.91 ($t = 2.451$, d.f. = 183, $p = 0.015$). Similarly, a significantly worse rating was given by heart disease sufferers (3.0 c.f. 3.88 for non-sufferers, $t = 2.636$, d.f. = 183, $p = 0.009$); hayfever sufferers (3.36 c.f. 3.98, $t = 2.953$, d.f. = 183, $p = 0.004$) and eczema sufferers (3.03 c.f. 3.96, $t = 3.706$, d.f. = 183, $p = 0.000$). Clearly, suffering from health conditions that may be related to air pollution seems to increase perception of the level of pollution. Howell *et al.* (2002) also found that people with chronic illness tended to rate air quality lower. This again may be related to ways in which people form knowledge about air pollution, which I discuss in chapter 6.

From the quantitative data, other variables were not associated with perceived levels of air quality. Variables such as length of residence in an area and socio-economic status had been suggested by some of the earlier literature on perceptions of air pollution to be related to perceived air quality (e.g. Medalia 1964, Evans Jacobs and Frager 1982, Swan 1970) but this was not found to be the case in this study.

The observed effects of the above illnesses on perceived air quality may of course be due to the different rates of occurrence of these illnesses in the different areas. To test the separate effects of illnesses and area while controlling for the others, a multiple regression was performed, which produced the following set of models:

Tables 4.2-4.4: Multiple regression modelling perceived local air quality

Model		Unstandardised Coefficients		Standardised Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	3.417	0.310	-	11.025	0.000
	gender	-0.094	0.200	-0.035	-0.472	0.637
	age	0.096	0.059	0.121	1.633	0.104
2	(Constant)	3.742	0.318	-	11.779	0.000
	gender	-0.135	0.193	-0.050	-0.698	0.486
	age	0.112	0.061	0.141	1.858	0.065
	asthma	-0.429	0.263	-0.122	-1.634	0.104
	chestprob	-0.246	0.337	-0.052	-0.732	0.465
	heartprob	-1.105	0.349	-0.240	-3.166	0.002
	hayfever	-0.258	0.221	-0.088	-1.168	0.244
	eczema	-0.589	0.270	-0.165	-2.179	0.031
3	(Constant)	4.538	0.301	-	15.089	0.000
	gender	-0.064	0.170	-0.024	-0.377	0.707
	age	0.104	0.053	0.130	1.949	0.053
	asthma	-0.462	0.230	-0.131	-2.009	0.046
	chestprob	-0.125	0.294	-0.026	-0.423	0.672
	heartprob	-0.881	0.310	-0.191	-2.845	0.005
	hayfever	-0.007	0.196	-0.003	-0.037	0.970
	eczema	-0.580	0.236	-0.163	-2.455	0.015
	HGS	-1.461	0.218	-0.499	-6.691	0.000
	BX	-1.605	0.265	-0.439	-6.066	0.000
	GPK	-0.793	0.225	-0.263	-3.530	0.001

Model		Sum of Squares	d.f.	Mean Square	F	Sig
1	Regression	5.189	2	2.594	1.451	.237
	Residual	321.729	180	1.787		
	Total	326.918	182			
2	Regression	50.224	7	7.175	4.538	.000
	Residual	276.694	175	1.581		
	Total	326.918	182			
3	Regression	119.607	10	11.961	9.923	.000
	Residual	207.311	172	1.205		
	Total	326.918	182			

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.126	0.016	0.005	1.337
2	0.392	0.154	0.12	1.257
3	0.605	0.366	0.329	1.098

In performing this multiple regression, the independent variables were entered in blocks following a causal order logic (Davis 1985). In the first model, only age and gender were entered, to check for effects that may confound other variables, and the model is not significant. In the second model, illnesses were entered as a block; having heart problems or eczema appeared to be associated with lower estimates of air quality, and this model is significant. Area was entered as the next block, with Totteridge as the reference category. In this model, which considerably raises the Rsq value, i.e. the amount of variance explained, all areas have significantly lower perceptions of air quality than Totteridge, and Brent Cross and Hampstead Garden Suburb are also lower than Grahame Park. Once area effects are brought in, having asthma, heart problems and eczema are seen to be significantly associated with worse perceptions of air quality. Interestingly, age is borderline significant with a positive coefficient, so increasing age may be associated with increasingly positive estimates of air quality.

Thus, from the quantitative data, both area of residence and possible medical susceptibility to the effects of air pollution seem to affect perceptions of residential air quality.

Turning to the qualitative data, there were clear differences between the different areas in the way that people spoke about the local air.

In Totteridge, the local air was generally perceived to be good or very good, in terms of levels of pollution (which was how the question was asked) - although not necessarily the best possible:

> Claire: Oh the quality is a very important factor, and it's very good, I mean if you put your nose out the window it's wonderful!

> Jean: So I would say that we're fairly well off when it comes to air pollution or air, the environment, quite honestly it's clean.

Mrs Chan: Not when you count the pollution, not the top, top one, but, compared with the rest is very good.

The way that people spoke about it was positive, as one of the many positive attributes of the residential area in which all those interviewed appeared to be happy.

This contrasts with Grahame Park, which was the other area of relatively low measured pollution, but socio-economically more deprived. In Grahame Park, most residents said that the air quality was OK, and not a problem locally, but it wasn't spoken of as being positively good – people spoke more in terms of an absence of any kind of problem, for example:

Dan: I don't think......pollution is a big deal here, you know, be it noise or, erm, manufacturing or what, I don't think pollution is a big deal or problem.

James: I think myself that round this neck of the woods, just round here, it's pretty reasonable, I must admit that.

Suzanne: I think it's just sort of normal.

The fact that here, compared to Totteridge, people spoke with less positivity despite the similar lack of a perceived air quality problem came across as related to the different levels of relative satisfaction with the areas in a wider sense. In Grahame Park, residents on the whole did not see the area in positive terms, and so were less likely to see actual positive qualities; this was not the case in Totteridge, where residents enjoyed describing how good the area was to live in and spoke of many positive attributes including aspects of the physical environment, the quietness and the pleasant neighbours.

In Hampstead and Brent Cross, the two study areas selected to be of higher ambient pollution, talk about air quality brought up much more negative perceptions.

In Brent Cross, there was a general feeling of the air being not so good, in a fairly unspecific way. There was an awareness of it being worse near the road, noticeable when walking across to Brent Cross shopping centre, or sometimes visible over the roads from the higher flats, but a couple of people also mentioned that it was better near the parks at the other end of the small estate, and down the side of the estate.

> Pam: we're quite healthy up here, the air's quite clean because I'm on the seventh floor, but generally pollution's very bad
> ...(later)...and it is bad when, walking to Brent Cross, sometimes you can really, you just know you're breathing in bad...

> Nigel: obviously it's not healthy traffic-wise .... that's the only thing that makes it unhealthy, cos of all the traffic the air is...

> Janet: And I must admit air quality must be pretty good with parks up that side, you know you've got the traffic going up there but you have got a big park up there, Clitterhouse Park,

The estate is surrounded by major roads, and these tended to be dominant in people's perceptions of the air, but the green spaces at the other end of the estate counted as a balancing factor to some extent.

Hampstead was interesting as, despite the fact that the interviewees all lived on, or very close to, a main road, the way that the local air was talked of was rather more complex. Some awareness of pollution was certainly shown, connected specifically with the road (most, though not all, interviewees expressed this). However in more general terms, and widening the locality out even slightly, once one was no longer right on the road, the air was perceived to be good, explained by the amount of greenery, the open spaces, and to some extent Hampstead's high location. So in terms of gauging local air quality, these two views seemed to co-exist, at times even in a rather paradoxical way.

> Mrs Kapoor: Fresh air I, not in this main road, but if you go, just go cross this,

Mr Farnham: Well apart from the pollution, yes, certainly, there's a lot of erm fresh air simply because of the green

Omar: open spaces, the heath is right next door, bracing air, it's supposed to be the highest spot in the area

Elaine: I mean if you live in London I don't know, I think this must be one of the most pleasant areas to live in for pollution, because you can walk straight through there to the heath, which is wonderful.........
(later) But I think overall it's not good probably.

Really there were rather similar reasoning processes in both Hampstead and Brent Cross, but the amount of greenery and open space in Hampstead allowed people's perceptions of the air in the neighbourhood to be less dominated by the road. The bad air around the road was clearly noted, but contained to this very specifically.

It seems then from the qualitative data that ideas about air quality might reflect or be affected by other feelings about the local environment as a whole. This had also been suggested in various ways by Bickerstaff and Walker (2001), Elliot *et al.* (1999) and Bush *et al.* (2001a). These subtleties in the way that people judge their air quality are more apparent in the qualitative data where people could talk at more length, and are hard to separate out in the quantitative data where people were asked to give a one-dimensional rating. The ratings given in the confines of the survey probably reflect more of an attempt on the part of the respondents to give an 'objective' rating of what they think the air quality is like, i.e. to guess the science, whilst during the course of an interview, more qualified, contextualised views and feelings were able to emerge.

However one way of testing some of the above assertions by looking again at the numerical data was devised, by using variables derived from the questions about the extent of other problems in the areas.

Question 2 on the survey had given a list of problems people might potentially encounter in their neighbourhood, of which air pollution was one, and asked respondents to rate how much of a problem they felt each one was in their area. From this, two new variables were derived: a measure of physical satisfaction/dissatisfaction, and a measure of social satisfaction/dissatisfaction. First of all, a cluster analysis was run on responses to question 2. This showed a clear clustering of variables into 4 groups, one relating to social factors, one to physical, one to do with traffic and the last consisting of burglary and parking. The first two clusters were used to make two variables: the first by adding together ratings of how much of a problem were drugs, unemployment, housing conditions, poverty and mugging; and the second by adding together responses relating to graffiti, vandalism and litter.

These two variables, and also the response from question 1 relating to how happy respondents were with the area where they live, were all correlated with rating of local air quality:

Table 4.5: Correlations of perceived local air quality with variables relating to the neighbourhood

		Q1	Q2PHYS	Q2SOC
localair	Pearson	0.198(*)	-0.201(**)	-0.263(**)
	Sig. (2-tailed)	0.014	0.008	0.004
	N	153	175	117

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

Overall level of happiness with the neighbourhood was positively correlated with perceived air quality, and rating of physical and social problems were both negatively correlated with perceived air quality. The correlations are significant, but do not represent a particularly large effect.

In order to pursue further the idea that these variables related to neighbourhood satisfaction may affect perceptions of air quality, they were added to the multiple regression model. Taking the earlier multiple regression model as a starting point (see tables 4.2-4.4), the two variables compiled from question 2 were then added as a further block (as they could clearly be caused by the area of residence hence need to be added later). This produced the following set of nested models:

Table 4.6: Multiple regression modelling perceived local air quality with additional variables

Model		Unstandardised Coefficients		Standardised Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	3.283	0.384	-	8.558	0.000
	age	0.143	0.078	0.173	1.849	0.067
	gender	-0.265	0.252	-0.098	-1.052	0.295
2	(Constant)	4.307	0.357	-	12.057	0.000
	age	0.139	0.065	0.167	2.121	0.036
	gender	-0.149	0.214	-0.055	-0.696	0.488
	HGS	-1.759	0.279	-0.582	-6.296	0.000
	BX	-1.804	0.342	-0.466	-5.282	0.000
	GPK	-1.159	0.277	-0.391	-4.189	0.000
3	(Constant)	4.363	0.356	-	12.251	0.000
	age	0.169	0.067	0.204	2.533	0.013
	gender	-0.195	0.207	-0.072	-0.942	0.348
	HGS	-1.657	0.269	-0.549	-6.151	0.000
	BX	-1.581	0.334	-0.408	-4.734	0.000
	GPK	-0.992	0.270	-0.335	-3.678	0.000
	asthma	-0.598	0.289	-0.172	-2.071	0.041
	chestprob	-0.482	0.349	-0.110	-1.384	0.169
	heartprob	-0.884	0.413	-0.177	-2.141	0.035
	hayfever	0.001	0.274	0.000	0.004	0.997
	eczema	-0.233	0.302	-0.067	-0.770	0.443
4	(Constant)	5.352	0.411	-	13.032	0.000
	age	0.189	0.064	0.228	2.940	0.004
	gender	-0.241	0.194	-0.089	-1.238	0.219
	HGS	-1.718	0.258	-0.569	-6.685	0.000
	BX	-1.128	0.337	-0.291	-3.351	0.001
	GPK	-0.119	0.332	-0.040	-0.359	0.720
	asthma	-0.745	0.273	-0.215	-2.725	0.008
	chestprob	-0.421	0.327	-0.096	-1.290	0.200
	heartprob	-0.537	0.403	-0.108	-1.332	0.186
	hayfever	-0.128	0.258	-0.041	-0.495	0.621
	eczema	-0.058	0.286	-0.017	-0.202	0.840
	Q2PHYS	-0.074	0.048	-0.185	-1.547	0.125
	Q2SOC	-0.062	0.033	-0.273	-1.882	0.063

Tables 4.7–4.8: Multiple regression modelling perceived local air quality with additional variables

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	7.668	2	3.834	2.145	0.122
	Residual	198.402	111	1.787	-	-
	Total	206.070	113	-	-	-
2	Regression	69.831	5	13.966	11.071	0.000
	Residual	136.239	108	1.261	-	-
	Total	206.070	113	-	-	-
3	Regression	89.472	10	8.947	7.904	0.000
	Residual	116.598	103	1.132	-	-
	Total	206.070	113	-	-	-
4	Regression	106.399	12	8.867	8.985	0.000
	Residual	99.672	101	0.987	-	-
	Total	206.070	113	-	-	-

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.193	.037	.020	1.337
2	.582	.339	.308	1.123
3	.659	.434	.379	1.064
4	.719	.516	.459	.993

This set of models cannot unfortunately be directly compared to the previous set, as the number of cases being used (reflected in the degrees of freedom) is smaller – due to some non-responses to parts of question 2 making some cases not eligible in the second set of models. There are some differences therefore in the earlier stages of the model, notably that having eczema is not a significant predictor of air quality rating.

In this set of models, adding the two variables relating to question 2 improves the fit of the model, in terms of the amount of variance in the dependent variable explained (45.9%, from the adjusted Rsq value), but neither parameter is significant, although the variable relating to social problems is close to significance which is worth some note. Many of the parameters are related which makes it difficult for the algorithm to estimate accurately the variance explained by each independent variable, and multi-collinearity may be a problem here although none of the bivariate correlations between independent variables are over 0.8, a rule of thumb at which point severe multi-collinearity is considered to render the model impossible to estimate (Mills *et al.* 1998).

As an alternative, adding only asthma as a variable at stage 3, and then adding the two variables related to question 2 at stage 4 produces the following final model:

Tables 4.9–4.11: Alternative multiple regression modelling perceived local air quality

Model		Unstandardised Coefficients		Standardised Coefficients		
		B	Std. Error	Beta	t	Sig.
4	(Constant)	5.467	0.390		14.030	0.000
	Age	0.170	0.060	0.205	2.843	0.005
	gender	-0.213	0.192	-0.079	-1.107	0.271
	HGS	-1.793	0.255	-0.593	-7.032	0.000
	BX	-1.173	0.334	-0.303	-3.509	0.001
	GPK	-0.064	0.330	-0.021	-.193	0.848
	asthma	-0.819	0.246	-0.236	-3.324	0.001
	Q2SOC	-0.084	0.031	-0.368	-2.664	0.009
	Q2PHYS	-0.060	0.047	-0.151	-1.271	0.207

Model		Sum of Squares	Df	Mean Square	F	Sig.
4	Regression	100.816	8	12.602	12.572	0.000
	Residual	105.254	105	1.002		
	Total	206.070	113			

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
4	0.711	0.506	0.463	0.990

This model explains more of the variance in the data (46.3%) with less variables and has a higher F value. Model selection in multiple regression is quite difficult and as discussed in chapter 3, different models could be selected which will give different results. However the composite variable Q2Soc seems from both of the above models to be having an effect and the implications of this model are of interest in the light of the above discussion.

This last model shows a significant effect of perceived poor social environment on rating of air quality, but not of perceived poor physical environment. The standardised beta coefficient is useful here as it shows the effect of a change in one standard deviation in the predictor variable on the dependent variable – possibly more useful than the unstandardised coefficient value, as the actual (raw) value of the composite variable is somewhat meaningless. In this model then, it seems that people perceiving a combination of drugs, unemployment, housing conditions, poverty and mugging to be a local problem were more likely to rate air quality lower, even controlling for which area they are in (which is a surrogate control for modelled physical pollution level) and independently from whether or not they suffer from asthma. Perceived physical environment however, in terms of vandalism, litter and graffiti, does not have an effect in this model. Of course it may be to some extent a fallacy to try to separate the two as in real situations they tend to be high in similar areas.

It is notable that once these variables are entered, the effect of living in Grahame Park alone is no longer significant – i.e. the difference between Grahame Park and Totteridge in ratings of air quality may be more explained by satisfactions with the neighbourhood in terms of these socially related problems, than by anything else such as physically measured pollution level. In this, explanations would seem to resonate with the qualitative data.

So far, then, it seems that perception of ambient air quality is fairly well related to the scientific data, but the survey data shows that susceptibility in terms of suffering from certain health conditions linked to air pollution may increase awareness, in terms of lowering perceived quality. The qualitative data shows that the way people feel and talk about their local air quality is influenced by the context of how they feel about the area in general – in the more pleasant areas people emphasised the good points of the area as a whole, and so downplayed the bad points of the air and minimised them geographically, although they could recognise them. The quantitative data is a little difficult to interpret on this point; there is some indication that a higher perception of social problems in the area may be related to a lowered estimation of air quality.

4.2 AIR IN CENTRAL LONDON

As well as being asked to rate their local air quality, in the questionnaire, people were asked to rate the air quality in central London, with the question, "How good or bad do

YOU feel the air is in Central London?" (Q4). The scale on which they were asked to circle a response was the same as that given for them to rate their local air quality.

The overall mean rating was 2.23 (s.e. 0.07), between quite bad and very bad, tending to very bad.

One –way analysis of variance showed that eczema sufferers again rated the air worse: 1.89 c.f. 2.3 for non-sufferers ($t = 2.275$, d.f. = 185, $p=0.024$). The other health conditions did not have an effect.

In terms of the different areas, there were no significant differences between perceptions of central London air at 95%, which lends weight to the perceptions of local air being significantly different between areas and not an artefact of the sample. However Hampstead was noticeably lower than the others with a mean rating of 2.02.

A pervasive theme in the interviews in all areas was that air pollution is worst in central London, and generally it gets worse the further into London you get.

> Mrs Coates: London, central London, really appals me,
> R: In what way?
> Mrs Coates: Because of air pollution, I can't breathe,

> Denise: the further you go into town, you can just, you can see it and you can feel it, the smog, and, definitely filthier.
> Dan: Central London, you know, I go into the city you know....Erm, exhaust fumes from these vehicles, you know, are [....] effect on the environment, and go to East London, you know, where they have these, massive industrial plants and other things you know.....

Within central London, particular locations such as Oxford Street and the 'West End' were mentioned several times as being especially unpleasant and polluted. These would probably be the most busy roads that the interviewees would frequent when in central London.

London was not just seen as having worse air, but in a broader sense was felt to be a dirty, bad, unhealthy environment. Bickerstaff and Walker (1999a, 2001) found very similar views in their study, regarding Birmingham city centre. The poor air was just one aspect of this, often not really articulated separately from the general sense of badness and unhealthiness. This sense of unhealthiness was associated very much also with litter and crowding as well as the traffic, all of which made it a generally difficult and stressful environment:

> Mrs Kapoor: London is so filthy....Yeah, the dirt, the paperwork and the rubbish that, all over, it's the rubbish so much, everywhere, and the paint looks so dreadful and old, and everything, it's not clean

> Omar: you just have to go down to Camden or whatever where, but that's congestion, where the density is higher, er, less trees, where there are more people, more shops, more hustle bustle, er, it gets more dusty, more litter is strewn around, er, that can't be er all that conducive to ones health, well-being I would imagine,

> Sally: yeah, traffic. It's disgusting, it's just I find anywhere you go in London, the minute you come out of the tube, it just, and also the crowds, it's just so packed everywhere you go. I find it moves too fast for me and that's the truth, I think, oh it confuses me, cos everyone's rushing and dashing about and they're all walking into you and, and I think no I could never ever, get used to that way of life, that speed, it just, I don't know I don't think they're very healthy those people, no, it's, I find the traffic, the tube, the rushing about, the crowds alone, are just ...

This was emphasised by the fact that being in Barnet, many of the respondents did not see themselves as essentially living in London, but viewed central London as really a quite different place, one which many of them seldom went to.

Expressions of the bad air of London can thus be interpreted as part of a whole view of London as a city being 'a different place', and one which was generally dirty, unpleasant, and even threatening. The quantitative ratings could be taken as a simple reflection of the fact that the air in London does tend to get worse the closer to the centre you are, but the qualitative data suggest that there is something more than this; people are expressing well-worn discourses about the city, and recycling a set of iconic images, which is interesting in itself, but also they are using this discourse in order to position themselves as being somewhere else, not part of that. The operation of both the material and symbolic levels simultaneously is reminiscent of Whittaker (1998)'s paper discussed in chapter 2, and the comment that a perceived environmental threat may "owe as much to the representational and symbolic realms as to material evidence".

4.3 LOCAL AIR RELATIVE TO CENTRAL AIR

Thus even the residents of Hampstead and Brent Cross tended to talk of local air quality as being better than (central) London, or good for London, or no worse than the rest of London:

> Elaine: I don't know I mean if you live in London I don't know, I think this must be one of the most pleasant areas to live in for pollution,

> Pam: I mean though I complain about it here, it's not as bad as it is at work.
> R right, in Westminster
> Pam: yes, I don't know how cyclists can go through, but it is erm, sometimes you come out of the tube station and it's just, your throat, you know, burns. With it. So that's not very, as bad here.

[There was an exception to this feeling though, from Brent Cross:

> Nigel: no I don't really notice it so much [in central London], I think maybe because it's a bit more built up or something, because it's quite open round here, but when you get into central London you've got all the buildings and

everything, I don't think you really notice the traffic fumes so much there, you know.

Nevertheless he did also mention Oxford Street as somewhere where he might notice the pollution from the buses and taxis.]

The pervasive tendency to see local air as better than central London air also showed up in the quantitative data. Subtracting scores for Q4 from those for Q3 created a variable indicating the perceived difference between local and central air. In all areas this was positive, i.e. air in all neighbourhoods was perceived as being better than in the centre. The mean scores were: Totteridge 2.48; Hampstead GS 1.2, Brent Cross 0.58; Grahame Park 1.5.

Performing an analysis of variance with LSD post –hoc test of significance (table 4.12) showed that on this variable, Totteridge was significantly higher than all the others, i.e. Totteridge residents thought themselves much better off relative to central London than did all the others. Brent Cross was significantly lower than all the others. It is interesting that Hampstead was significantly higher than Brent Cross, so although in absolute terms they may not consider their air to be actually better (no significant difference for question 3, although the tendency was in that direction) Hampstead residents did appear to consider their air to be cleaner in relative terms – 'not bad for London'. The scientific data on the other hand gives a worse estimate for air quality in Hampstead than in Brent Cross.

Table 4.12: Differences in mean perceived relative air quality between the 4 study areas

(I) area	(J) area	Mean Difference (I-J)	Std. Error	Sig.
Totteridge	Hampstead GS	1.2763(*)	0.22800	0.000
	Brent Cross	1.8938(*)	0.27116	0.000
	Grahame Pk	0.9800(*)	0.24315	0.000
Hampstead GS	Totteridge	-1.2763(*)	0.22800	0.000
	Brent Cross	0.6175(*)	0.26745	0.022
	Grahame Pk	-0.2963	0.23901	0.217
Brent Cross	Totteridge	-1.8938(*)	0.27116	0.000
	Hampstead GS	-0.6175(*)	0.26745	0.022
	Grahame Pk	-0.9138(*)	0.28048	0.001
Grahame Pk	Totteridge	-0.9800(*)	0.24315	0.000
	Hampstead GS	0.2963	0.23901	0.217
	Brent Cross	0.9138(*)	0.28048	0.001

* The mean difference is significant at the .05 level.

As I made the point above, using the iconic idea of the city allowed people to rationalise their own area as better, and this was particularly apparent in Hampstead. By deploying this discourse, they were able to rationalise their neighbourhood as still a good and relatively healthy place to live.

The general tendency for people to consider their local air better than other places, or to locate the problem elsewhere, has been noted several times in previous research (Thouez and Singh 1984; Kromm 1973; Wall 1973; Bickerstaff and Walker 1999a; 2001). Bickerstaff and Walker in particular found similarly that people saw Birmingham city centre as having the worst air quality in Birmingham as a whole, and this was also related to the centre being seen as untidy, built up and lacking greenery; they also found that in all parts of their study locality people felt their local air to be better than in the city centre. To the above authors, this process of locating pollution elsewhere is often seen as a form of denial of risks to the respondents personally. However, as I discussed in chapter 2, this is a problematic conclusion when the physical comparative dimension is not addressed, i.e. it is hard to know whether people are responding to a tangible physical difference or whether they are indeed constructing a distinction for more psychological purposes, or both. Nevertheless my analysis would support a theory that at least to some extent, a process of making the city centre 'other' in order to keep a positive place identity of the local, can occur. This resonates with Bush *et al.*'s (2001a) theory about expressions of air pollution being used as part of a process of stigmatisation of a place.

4.4 WHAT CAUSES AIR POLLUTION?

In the qualitative interviews, in all the study areas the major cause of air pollution in the present was seen as traffic. That given though, there also seemed to emerge some important differences between the neighbourhoods in the way that people talked about the sources of pollution.

In Totteridge, air pollution in the locality was not really seen as a problem overall. However, bad spots outside the immediate streets, but still within what may be termed the local area (say walking distance), were identified, particularly Whetstone High Road and Totteridge Lane, and particularly during the rush hours. As such, any local pollution was attributed to traffic, for example:

> Phil: I should imagine the air quality's pretty damn good round here, you know, I should imagine so, but having said that I mean there are major roads in the area, Totteridge Lane which is, in the morning's choc-a-bloc both ways,

In Hampstead, traffic on the road was fairly clearly blamed for any local problem, though, as explained above, there was less emphasis on pollution being a local problem than might be expected. As part of the general traffic problem, HGVs were somewhat singled out for blame:

> Omar: I don't know what's in diesel and so on, I know people er, [..] heavy lorries and heavy good, coming from Europe and so on, what standards apply to different countries, they are travelling from north to south, south to north etc, passing from here into the city,

Karen: I mean if you reduced, if you took out erm, the HGV vehicles, you know the heavy goods vehicles [on the A1] that would reduce it a lot.

In Brent Cross, pollution was talked about mostly in a local context, with the emphasis being on traffic (in a generic sense) from the surrounding A roads. Less distinction was made between types of traffic, though one person voiced the view that buses and lorries were particularly bad[10]. Another (a driver) talked of the railway, the local dump, and traffic to the local building yard as being contributors to the dust in the air.

In Grahame Park, pollution was not really seen as a local problem, but the lack of pollution locally was explained by the lack of through roads and so the lack of traffic (generically, and talked of as cars) going through the estate:

Caroline: because we're on the edge and we're not sort of like in town and there's no, there's no like through road through the estate, there's none of that sort of like pollution,

As a London issue, in general interviewees from all the neighbourhoods put air pollution down to traffic exhausts, and the amount of traffic on the roads, and often there was a strong emphasis on HGVs and buses in particular. This was very likely related to the greater visibility of diesel exhaust compared to petrol car exhaust.

Jean: It's usually buses and lorries I think.

Siobhan: I also think double deckers, [...] the smoke they would spew out of them, I have just a bad image of buses, you know that they spew all of this stuff out... worse than cars though, you know

Mr Robson: but they got the buses spilling out all the diesel, it's choking you up,

[10] No quote is possible here as the recording of this interview was not audible.

It was noticeable however, in Totteridge especially, that inasmuch as cars were seen to be a major cause of air pollution, the problem was put down to older cars, or cars running on diesel or unleaded petrol:

> Phil: always seems this way, you get stuck behind that guy hasn't re-serviced the last umpteen years, and there he go and puts his foot on the accelerator, a great big plume of.... it smells like burnt almost,

> Denise: lorries with smoke coming out, and people putting wrong petrol in their cars, and, that really makes me mad when I see that smoke coming out of exhausts.

So in the course of the interviews, although they acknowledged cars as polluting, people were able to exonerate themselves at least somewhat as their cars were well serviced and running on unleaded petrol:

> Kate: but you know, we all drive, but ... I'm sure my car doesn't put so much rubbish..

> Mrs Coates: I mean I use unleaded petrol, my husband uses unleaded petrol, but we still use a car.....

This was interesting in the light of the reliance on cars in Totteridge. Many of the people interviewed were two, three or even four car families, and informed me that this was usual for the area.

> Phil: But I should imagine per head of the population, there are a hell of a lot more cars round this area than there are anywhere else. I mean just looking at the two houses next door, 4 that way, that's one per person, 3 that way, that's one per, well, 4 people in the family there, car each, 4 people in the family here, 3 cars.

As well as other road traffic, air traffic came up several times as a major cause of air pollution in the Totteridge interviews:

> Claire: I was listening to a report on the television about erm, on channel 5, and how, erm, air traffic is contributing to air pollution and the ozone layer, and I think, it is so short sighted of governments not to take that on board!
>
> Mrs Coates: But then you've got to talk about aeroplanes. Which pollute more than anything else don't they?

Other factors in causing pollution which were mentioned in Totteridge included general atmospheric dust; incinerators; industry; general litter; weather – hot and humid weather making it worse; and London's location in a basin.

Air traffic was also brought up two or three times in the Hampstead interviews as a significant contributor to air pollution:

> Elaine: because they spew out a huge amount, buses, and planes do as well, I believe.
>
> R And erm, what would you say the pollution is, what would you say causes it?
> Karen: well one is the traffic, the traffic, and secondly it's the flight path as well to Heathrow, goes straight across there, they come in here, turn and go out to Heathrow, so I notice that, there's always planes going over out back garden, so I'd say that,

I started to think that this might be a pattern among car drivers to look for explanations of pollution other than themselves. In Brent Cross and Grahame Park, where there were fewer car drivers, there was less distinction made between different kinds of traffic and air traffic was not mentioned at all as a source of pollution.

In Brent Cross as well, although there were fewer drivers, one driver had this to say:

> Pam: yes, the ozone layer, but it isn't us, I mean, these cars along here are not doing half the damage one of those American missiles are doing. You see it's no good them preaching to us about, and getting our cars off the road, it's got to come from the top, when they get in their, the prime minister gets in his little air force jet and shoots off round the world, that takes, you know? So, I'm fairly cynical!

From the interviews, it seemed that though it was hard to be conclusive there was definitely evidence to support an argument that the car drivers, who were concentrated in Totteridge and Hampstead, whilst certainly blaming cars for pollution, were more inclined to place the blame at the door of others, whether HGVs, buses, drivers of older cars, or air traffic. In both Brent Cross and Grahame Park, traffic was talked of in more generic terms, with people feeling less need to make the distinction between types of traffic and their relative contribution. In Brent Cross, interestingly, those who did seek explanations other than traffic, or cars, were the car drivers, which would seem to reinforce this argument (there was only one driver in Grahame Park).

In the survey, the view that traffic was the main cause of air pollution showed up strongly. People were asked to rate how much pollution each of a list of factors caused, both in their neighbourhood and in central London (Q5 and Q6, appendix 5). Below are the tables of each in rank order. Each was rated on a 5 point scale from 1 = none to 5 = a very large amount. Those in bold indicate significantly higher and lower groups.

Table 4.13: Perceived causes of local air pollution

Pollution source	Mean rating	Std. error
Cars	**3.87**	**0.07**
HGVs	**3.48**	**0.09**
Buses	**2.98**	**0.08**
Pollen	**2.70**	**0.09**
Building / roadworks	2.61	0.08
Domestic heating	**2.27**	**0.08**
Weather	**2.19**	**0.08**
Industry	**2.16**	**0.10**
Planes	**2.08**	**0.08**
Bonfires	**2.01**	**0.07**

Table 4.14: Perceived causes of air pollution in central London

Pollution source	Mean rating	Std. error
Cars	**4.51**	**0.05**
HGVs	**4.24**	**0.07**
Buses	**4.18**	**0.07**
Building/roadworks	3.84	0.07
Industry	3.40	0.10
Planes	2.98	0.10
Weather	**2.76**	**0.10**
Pollen	**2.64**	**0.10**
Domestic heating	**2.57**	**0.09**
Bonfires	**1.80**	**0.08**

So both locally and centrally, cars, HGVs and buses were seen as the major causes of pollution. Locally pollen was seen as more of a polluter than centrally.

Looking at the results by area shows little differences in the rankings either for local pollution or for central London. For central London there were few differences in the ratings of each pollution source as a problem. However, locally, the ratings of each separate possible pollutant showed some points of interest.

There were no significant differences between the 4 neighbourhoods in the rating of pollution caused by buses locally, which is perhaps surprising given that the number of buses varies a lot between the areas. This may be due to resilient images of buses being polluting, or people thinking of the wider neighbourhood as opposed to their street when answering this question, and so taking into account local main traffic routes.

Brent Cross respondents rated industry as significantly more of a problem locally than did respondents in any of the other areas - 3.17 in Brent Cross c.f. 1.94, 2.08 and 2.57 in Totteridge, Hampstead and Grahame Park respectively. This may account for Brent Cross's somewhat worse view of their air than Hampstead, and is probably due to the presence of a waste disposal place on one side of the estate and a builders' merchant nearby.

In the survey the theory about planes being blamed more in Hampstead and Totteridge was not borne out, as they were not rated differently in the different areas. This was a slightly different scenario from the interviews perhaps, as in the questionnaire the list of possible sources of pollution was given, whereas in the interviews people were left to name sources spontaneously. My idea was that rating of sources of pollution had been related to the amount of car use and so I examined differences in ratings of each pollutant as a problem against transport means: those using a car or taxis as their main mode of transport compared to those using all other modes (public, cycling, motorbike, walking).

Surprisingly, car users saw cars as greater polluters locally than did non-car users: 4.18 c.f. 3.71 ($t = 3.608$, d.f. = 169.6, $p = 0.000$). They also saw cars as causing more pollution in central London (4.65 c.f. 4.42, $t = 2.310$, d.f. = 177, $p = 0.022$). This may have had something to do with a feeling of guilt, or that they should acknowledge responsibility - in Q17 car users saw themselves as having greater responsibility for doing something about air pollution than did non car users: 4.26 c.f. 3.92 on a 1 to 5 scale ($F = 4.294$, d.f. = 184, $p = 0.04$).

However, car users also rated building and roadworks as a greater polluter locally (2.84 c.f. 2.5 for non car users; $t = 1.987$, d.f. = 173, $p = 0.049$) and centrally (4.06 c.f. 3.69, $t = 2.526$, d.f. = 147.4, $p = 0.013$); they rated HGVs as greater polluters centrally (4.46 c.f. 4.12, $t = 2.538$, d.f. = 168.8, $p = 0.012$) and they rated buses as greater polluters centrally (4.51 c.f. 3.98, $t = 4.205$, d.f. = 170.7, $p = 0.000$). It may be that exposure to pollution from driving made car users more likely to rate both cars and other sources more highly, or this could be a confirmation of the tendency in the interviews to temper their own responsibility by increasing the blame on other sources as well.

Suffering from some health conditions listed in Q46 also affected ratings of how much pollution was caused by each polluter, particularly for asthma sufferers:

Table 4.15: Ratings of sources of local pollution for asthma sufferers compared to non-sufferers

	mean rating				
Local pollutant	Asthma	No asthma	F	d.f.	p
bonfires	2.34	1.94	4.59	180	0.033
buses	3.37	2.91	4.46	189	0.036
Building/roadworks	3.03	2.54	4.88	179	0.028
Cars	4.16	3.82	3.17	192	0.077
Planes	2.52	2.00	5.51	174	0.020
Domestic heating	2.67	2.19	5.81	170	0.017
pollen	3.27	2.57	10.41	179	0.001

There was some indication that hayfever/rhinitis sufferers and eczema sufferers also had some raised perception of pollution caused locally by certain sources, though not to the same extent that asthma sufferers had. This was not the case for chest or heart problem sufferers. Interestingly, asthma sufferers did not give higher ratings for central London sources of pollution either.

4.5 THE IMPORTANCE OF AIR POLLUTION AS AN ISSUE

Here I was interested in how salient an issue air quality seemed to be, and how concerned people were over air pollution. There were various aspects to this.

4.5.1 The significance of local air quality

In Totteridge, Hampstead and Brent Cross, when asked if they thought the area was a healthy place to live, many people spontaneously raised issues to do with air quality, or pollution, with no prompting. This is interesting because it suggests that whatever degree of importance people place on it, air quality may be an important component of how people perceive their environment in terms of health.

In Totteridge, the majority spontaneously said that the area was healthy due to the lack of pollution, and it was often the first thing mentioned:

> Phil: Oh yes, yes.......healthy...I mean I don't think, I doubt if we have much traffic pollution, not like it was along Farringdon Road, where your mum lives [to wife],

> R: Do you think it's a healthy place to live, is that something you ever think about?
> Denise: I do actually, yeah, I do think it's healthy because there's much more wide open space here, erm, you don't get the traffic and the pollution.

This came strongly linked with the presence of greenery and open space which it was felt contributed to health; other factors were lack of stress, safety and nice neighbours.

In Hampstead Garden Suburb, when asked if the area was healthy, again people often responded immediately in terms of the air. These comments were mixed in terms of its evaluation:

> R Well, would you say that it's a healthy place to live here, generally?
> Mrs Kapoor: Er generally, yes, fresh air, er.....safe, healthy,

> Mr Farnham: Well apart from the pollution, yes, certainly, there's a lot of erm fresh air simply because of the green

> Siobhan: well I wouldn't think it's that healthy with, living on the road [laughs] personally but.. erm, yeah I think it's, I mean it's as healthy as anywhere else you're going to get in London I think, because there's a lot of green like,

Again the perceived quality of the air, linked strongly with the greenery around, seemed to be an important aspect of people's experience of the area as healthy. In both Totteridge and Hampstead, the air and the greenery could be seen as important elements of a 'therapeutic landscape' (Gesler 1992;1993).

In Brent Cross, questions about the healthiness of the area brought up some spontaneous references to traffic, straight away,

> R So do you think it's a healthy place to live here, is that something you'd ever think about?
> Pauline: Personally no, because of the traffic, the pollution,
>
> R: So, do you think it's a healthy place to live here?
> Norman: Traffic-wise, no
>
> R So would you say it's a healthy place to live around here?
> Nigel: I would say healthy to an extent of the traffic, obviously it's not healthy traffic-wise, because, you know I must admit I'm not helping the environment by driving, but, with all the traffic and everything, that's the only thing that makes it unhealthy, cos of all the traffic the air is...

In both Hampstead and Brent Cross however it was actually quite difficult to separate out air pollution as a problem; what emerged more in some of the interviews was a set of problems associated with living by major roads, of which pollution was one. Noise came up a lot; also, to a lesser extent, speeding and traffic accidents.

> Siobhan (Hampstead): It's funny, I would say noise pollution is the thing that I would notice more than even the air.
>
> Mrs Kapoor (Hampstead): main road, traffic, crossing problem, car come very fast, ...speed not good, speed not good because the cars are very fast and you cannot cross...... Pollution, obviously, pollution, erm..... so.... I think this is a major problem for any, mayor is trying to handle it but not easy.

R : What do you think's the worst thing about traffic?
Pam (Brent Cross): noise, and crossing the road, it's very difficult to get out of here in the morning, the amount of traffic, they use this as a cut through you see,

R: So would it be the noise that would bother you more than the dust or the pollution?
Julie (Brent Cross): [pause] yes because, I can hear that and I can see it, the pollution is like silent, menace out there and I'm not... aware of it,

In Grahame Park, unlike the other areas, thoughts about the healthiness of the area were not strongly associated with perceptions of the air quality. Remarks made were more about the standard of the housing and the number of people housed on the estate. As discussed at the beginning of the chapter, the air was seen to be unproblematic, rather than positively good, which perhaps reflects the general perceptions of the area.

However, it is also interesting to look at the rating of air pollution relative to other problems in the different study areas. The following tables give the ranked ratings of neighbourhood problems for each of the four areas taken from question 2 in the survey. Here respondents had been presented with a list of possible problems in the neighbourhood and asked to rate how much of a problem they thought each was in their local area. The scale on which they should answer ranged from 1 = not a problem at all, to 5 = a very big problem. Significantly higher and lower groups are marked in bold.

Table 4.16: Mean ratings of neighbourhood problems in Totteridge study area

Problem	Mean	Std. Error
congestion	**3.52**	**0.16**
parking	**2.98**	**0.19**
road safety	**2.94**	**0.13**
burglary	**2.90**	**0.14**
air pollution	2.44	0.15
graffiti	2.39	0.17
litter	2.19	0.11
mugging	2.14	0.12
vandalism	2.13	0.13
noise	2.08	0.14
drugs	**1.88**	**0.16**
unemployment	**1.86**	**0.12**
poverty	**1.62**	**0.12**
housing	**1.58**	**0.13**

In Totteridge (table 4.16 above), air pollution ranked as the 5th highest problem, but significantly lower than congestion only, and significantly higher than poverty and housing only.

Table 4.17: Mean ratings of neighbourhood problems in Hampstead Garden Suburb study area

Problem	Mean	Std. Error
air pollution	**4.02**	**0.13**
congestion	**4.02**	**0.11**
road safety	**3.72**	**0.15**
noise	**3.69**	**0.16**
parking	**3.67**	**0.18**
burglary	**3.50**	**0.15**
litter	3.02	0.14
vandalism	2.22	0.12
graffiti	**1.94**	**0.11**
unemployment	**1.71**	**0.14**
mugging	**1.68**	**0.13**
drugs	**1.61**	**0.16**
housing	**1.53**	**0.13**
poverty	**1.47**	**0.11**

In Hampstead Garden Suburb (table 4.17 above), air pollution was the top ranked problem, part of a group of problems that were clearly related to living on the main road. Air pollution was significantly higher than litter and anything that ranked below litter.

Table 4.18: Mean ratings of neighbourhood problems in Brent Cross study area

Problem	Mean	Std. Error
air pollution	**3.82**	**0.21**
congestion	3.46	0.21
graffiti	3.29	0.24
vandalism	3.24	0.23
Road safety	3.24	0.21
unemployment	3.20	0.23
noise	3.17	0.23
drugs	3.10	0.24
poverty	3.04	0.25
litter	3.00	0.22
housing	2.76	0.23
parking	**2.65**	**0.24**
burglary	**2.59**	**0.20**
mugging	**2.50**	**0.21**

In Brent Cross, air pollution was the highest ranked problem again, but due to large standard errors appeared significantly higher than parking, burglary and mugging only. Concerns over the physical environment in general were higher here than in Hampstead.

Table 4.19: Mean ratings of neighbourhood problems in Grahame Park study area

Problem	Mean	Std. Error
drugs	**4.08**	**0.16**
graffiti	**3.83**	**0.16**
vandalism	**3.79**	**0.16**
litter	**3.76**	**0.15**
unemployment	3.67	0.19
poverty	3.54	0.19
parking	3.25	0.18
burglary	3.23	0.18
housing	3.22	0.18
mugging	3.04	0.18
air pollution	3.04	0.17
noise	2.92	0.19
congestion	**2.71**	**0.20**
Road safety	**2.46**	**0.18**

In Grahame Park (table 4.19 above), drugs and the physical environment dominated local concerns, followed by other social problems. All problems were ranked relatively highly, apart from the traffic-related ones. Air pollution was ranked fairly low, but significantly lower than drugs only, due to the standard errors. This is interesting in comparison to Totteridge, where pollution is physically the lowest, but appeared much higher up the list, as in Totteridge social problems were a much lower concern.

The above shows how air pollution featured as a local concern in relative terms in the different study areas. The responses to question 2 on the survey can also be used to compare ratings of air pollution as an absolute measure.

The mean ratings of air pollution as a problem in each of the 4 areas were as follows:

- Totteridge 2.44 – a slight to moderate problem
- Hampstead GS 4.02 – a fairly big problem
- Brent Cross 3.82 – close to a fairly big problem
- Grahame Park 3.04 – a moderate problem.

One-way analysis of variance showed some significant difference between areas ($F = 20.783$, d.f. = 190, $p = 0.000$). Post-hoc testing using Tukey's test showed the following results:

Table 4.20: Differences in mean ratings of air pollution as a local problem between the 4 study areas

	(I) area	(J) area	Mean Difference (I-J)	Std. Error	Sig.
Tukey HSD	Totteridge	Hampstead GS	-1.58(*)	.219	.000
		Brent Cross	-1.38(*)	.248	.000
		Grahame Pk	-0.60(*)	.222	.038
	Hampstead GS	Totteridge	1.58(*)	.219	.000
		Brent Cross	0.19	.246	.858
		Grahame Pk	0.98(*)	.220	.000
	Brent Cross	Totteridge	1.38(*)	.248	.000
		Hampstead GS	-0.19	.246	.858
		Grahame Pk	0.78(*)	.249	.010
	Grahame Pk	Totteridge	0.60(*)	.222	.038
		Hampstead GS	-0.98(*)	.220	.000
		Brent Cross	-0.78(*)	.249	.010

* The mean difference is significant at the .05 level.

In Totteridge, air pollution was seen as significantly less of a problem than in all the other areas. In Grahame Park, it was seen as significantly more of a problem than in Totteridge, but less than in Hampstead or Brent Cross. Hampstead and Brent Cross were not different from each other in the rating, but air pollution in both areas was seen as a greater problem than in Totteridge or Grahame Park. This follows the pattern of the perceived levels of pollution and again roughly corresponds to the scientifically modelled levels.

Suffering from the health conditions in q46 also affected how much of a problem people thought air pollution in their neighbourhood to be. Chest problem sufferers rated it as more of a problem than non-sufferers (mean 4.00 c.f. 3.23, $t = 2.318$, d.f. = 189, $p = 0.022$); as did heart problem sufferers (mean 3.94 c.f. 3.23, $t = 2.108$, d.f. = 189, $p = 0.036$), hayfever/rhinitis sufferers (mean 3.71 c.f. 3.13, $t = 2.891$, d.f. = 189, $p = 0.004$) and eczema sufferers (mean 3.89 c.f. 3.16, $t = 3.076$, d.f. =189, $p = 0.002$).

As with the perceived level of pollution, the variables composed from question 2 relating to the physical and social environment both correlated with seeing air pollution as a problem:

Table 4.21: correlation of rating of air pollution as a problem with variables relating to other neighbourhood problems

		Q2SOC	Q2PHYS
Air poll problem	Pearson Correlation	.279(**)	.195(**)
	Sig. (2-tailed)	.002	.008
	N	121	182

** Correlation is significant at the 0.01 level (2-tailed).

Following the method used previously for the testing of variables against perceived level of pollution, a multiple regression was performed to test for the effects of these variables on rating air pollution as a problem, when controlling for the others. The same variables were entered in the same blocks as previously (see tables 4.02 – 4.11), producing the following final model:

Tables 4.22–4.24: Multiple regression modelling rating of air pollution as a local problem

Model		Unstandardised Coefficients		Standardised Coefficients		
		B	Std. Error	Beta	t	Sig.
4	Constant	0.844	0.374		2.259	0.026
	age	-0.003	0.058	-0.004	-0.053	0.957
	gender	-0.131	0.175	-0.051	-0.750	0.455
	HGS	1.704	0.234	0.589	7.289	0.000
	BX	1.022	0.299	0.282	3.414	0.001
	GPK	-0.247	0.303	-0.088	-0.814	0.418
	asthma	0.163	0.243	0.050	0.673	0.502
	chestpro	0.726	0.299	0.172	2.430	0.017
	heartpro	0.142	0.368	0.030	0.385	0.701
	hayfever	0.511	0.226	0.173	2.259	0.026
	eczema	0.003	0.253	0.001	0.010	0.992
	Q2SOC	0.064	0.029	0.295	2.194	0.030
	Q2PHYS	0.110	0.043	0.290	2.580	0.011

Model		Sum of Squares	Df	Mean Square	F	Sig.
4	Regression	105.135	12	8.761	10.602	0.000
	Residual	85.942	104	.826		
	Total	191.077	116			

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
4	0.742	0.550	0.498	0.909

When looking at the partial effects of each variable, then, having chest problems or hayfever/rhinitis, rating of social problems in the area, and rating of the physical problems as higher, seem to be related to increased rating of air pollution as a problem. Despite the fact that other problems may be seen as more important, this does not seem to lead to seeing air quality as less important in absolute terms, but rather may even be associated with seeing air pollution as more of a problem. Of course it is problematical to conclude a direction of causality, but in conjunction with the similar finding regarding the rating of air quality described earlier, it does seem that rating of local air quality and of air pollution as a problem, as well as reflecting the physical levels present, may in part reflect other dissatisfactions with the neighbourhood. Again, once this effect is accounted for, there is no longer a significant difference between Grahame Park and Totteridge in terms of other area effects, i.e. this effect may account for the greater rating of air pollution as a problem in Grahame Park as compared to Totteridge.

Air pollution as a local problem therefore needs to be seen in context in three ways: first, it tends to come as part of a cluster with other road related problems; second, its relative importance changes depending on other perceived local problems, but third, its absolute level of being a perceived problem may still be in part raised by the presence of other social and physical problems.

4.5.2 Concern over air pollution

In Totteridge and Hampstead, most people in the long interviews did not express concern over air pollution for themselves personally. This was mostly because it did not affect them, either because of where they live or because they did not perceive themselves as vulnerable to the effects in terms of health. People therefore saw it as something they didn't think about much.

> Kate (Totteridge): I don't worry about it, I don't, I don't worry about it because I live here I suppose, if I lived, somewhere much more built up, and I didn't have the choice of moving, then I might feel very differently,

> Ken (Totteridge): We may be not so aware of it because none of our family suffer with chest problems or bronchial problems, if you've got someone in the family, then you'd be far more aware I would think.

> Erica (Hampstead): I think I'm not, I'm not consciously on a daily basis thinking about pollution.

> Karen (Hampstead): It's only when you talk about it that you think about it, but I don't think generally that I think about it, it's only talking about it.

This is interesting in Hampstead because in the survey, respondents in this area did rate their air quality as poor and also saw air quality as a relatively high problem in the area, when given it on a list.

In Brent Cross, when air quality was discussed specifically, the overriding view was one of acceptance, or not really thinking about it, including from the woman who thought it affected her and her daughter's allergy problems:

> Janet: as I said I mainly worry about it when it affects, when I'm worst affected, but I....unless that happens I try not to think about it, because you just have to get on with your daily, living, I mean......

> Nigel: [I] don't really take much notice of it, you know it's only because it's been mentioned, but otherwise it just er, you know treat it as, it's just a part of life sort of thing, you just accept that it's there and that's it, you know.

> Julie: normally I'm too busy to be.... concerned with day to day things to give it a huge amount of thought...

Clearly this had quite a lot to do with a feeling that there is little they can do to change it. However, another context was that on the whole the estate residents were very happy living there and felt it to be a good community with many good points:

> Nigel: I'm not sort of complaining about it, but just mention the fact that, that's the only problem about living here is the noise, the traffic but apart from that it's very nice, you know, I like living here.

Among those interviewed in Grahame Park, only the worst asthmatic felt it was important for her personally, but talking about it generally, most people expressed the view that something needed to be done about air quality, especially in London, with reasonable degrees of concern:

> Sally: Yeah, I think they seriously need to address it, especially like I say in London, yeah, because I think it is a big problem, a big problem, and the traffic and that, you know,

Interestingly, only one person in Grahame Park said that she didn't really think about it:

> Michelle: I suppose it's quite interesting if you try and get into it or you've got to because of your health, or, whatever reason, but, it don't really bother me.

However the feeling that people on the whole have more pressing things to worry about was also expressed:

> Mr Robson: I think the ordinary people here, in life, they're just going about their business. I think that, you know, they wake up in the morning, they're looking at the situation and they're running round and saying well I gotta go down the shop, I gotta get a bit of food in, you know what I mean, I don't think they take a lot on board, which they should do, but they don't , they just say to themselves well that's it, I've got to get the food in, I've got to pay my bills off...

It seemed then from the interviews that there was not overall a very high level of day-to-day concern about air pollution at a local, personal level, in any of the study areas. For some, this was because they did not feel vulnerable, either because their local air is good or because they did not feel vulnerable in terms of their health. For others, notably in the poorer areas, they did not worry about it because they felt they could not do much, or because they had other, more pressing, things on their minds.

This gives a slightly different impression from the rating in the survey of air pollution as a local problem discussed above. Some of the difference can be accounted for by people not feeling personally vulnerable to the effects of pollution. Some of the remarks also reflect the fact that air pollution might be of less concern in relative terms than other problems. There are also methodological issues: when prompted, by having air pollution raised as subject on a list, as in a survey, people may react more strongly even though it is not something they normally think about. There is also an issue that the interviews reflect only a few people in each area.

4.5.3 The Global Dimension

However, many concerns were expressed in a more abstracted sense about air pollution as a global issue. In all cases this was without any prompting, and in fact the interview schedule had been very much framed in terms of the local environment. Nevertheless, links were made time and time again with global warming and ozone depletion. These comments came from Totteridge and Grahame Park in particular, and it was over these issues that a higher level of concern was expressed:

> R: And how important an issue would you say it is?
> Mrs Coates (Totteridge): Well I think it's extremely important, globally, we've got to do something.
>
> Paul (Totteridge): at the end of the day air pollution is a global issue, you know the ozone layer, the ozone problem, you know is a problem basically in Australia and it's a problem you know at the north pole, you know, that's where it starts, you know it's going to work its way round to us you know
>
> Gianni (Totteridge): I suppose with the onset of global warming problems, with the er, the changing of the seasons and that, winters becoming milder and icecaps melting and sort of, from sort of the global point of view, that sort of first brought it to, rather than at the personal level ....
>
> Sally (Grahame Park): you know it's got to take its toll sooner or later hasn't it, I mean look at the way the weather's changed in this country, and I think people are starting to realise, that something is happening, you know and why is it happening, you know we're getting summers like abroad, and then other times we're getting the winters like you know, sort of, funny places.
> Mr Robson (Grahame Park): well the, the global warming, they are actually looking at it more wider than before, you know, because lets be honest, it is getting a little bit over the top, as far as I can see, you know they've got to take this in consideration, I mean you're living on this planet, to a certain extent we're abusing it, you know, and er, we got to look at the next generation,

R So do you think something should be done about air pollution?

Omar (Hampstead) Of course, good heavens, er, it's er not just a local or national problem it's a global problem,

In Hampstead air quality was overall framed as more of a London issue with only the one remark (above) made about the global scale. Interestingly, Brent Cross was the only neighbourhood where air pollution was framed more in terms of the locale, and none of the interviewees there talked of the global aspect.

This is very different from what previous research has shown, and in particular contradicts the theory of Bush *et al.* (2002), discussed in chapter 2, that environmental risks such as air pollution are seen in the context of local experience rather than as a globalised risk in the sense that Beck talks about. Here the global nature of the problem seemed particularly salient and in fact it was through this dimension that many of the interviewees felt most concerned. This may represent a development from earlier research and may have been partly brought on by the much publicised refusal of the US to sign an agreement on greenhouse gas emissions in Kyoto, shortly before the first interviews were conducted. Nevertheless a strong sense of perception of a growing and unforeseen global risk did emerge, a sense that resonated very much with Beck's (1992) analysis. Only in Brent Cross did pollution seem to be seen through the local context, perhaps because they experienced it more locally.

Some of these attitudes were tested in the survey, with the list of attitude statements in question 31, where respondents were asked to indicate how much they agreed or disagreed with a list of statements. The statements were designed to reflect aspects of concern, the scale at which air pollution was seen to be a problem, and also issues of resignation or (lack of) control.

In terms of scale, the overall mean response to the statement 'I think that air pollution is a problem on a world wide scale' was 4.45 (s.e. 0.05) – agree to agree strongly. There were no differences between the different areas for this, or by any of the other variables.

The statement 'I think the air in my neighbourhood needs to be improved' scored a mean of 3.75 (s.e. 0.07) – neutral to agree, tending to agree. The means for the different areas were: Totteridge 3.39, Hampstead 4.13, Brent Cross 3.76 and Grahame Park 3.71. The only significant difference at 95% was between Totteridge and Hampstead ($p = 0.000$). It is interesting that Brent Cross and Grahame Park were similar despite both the modelled physical levels and the perceived levels of pollution being different. This could reflect the similar degree of fatalism in the two areas, or the degree of general dissatisfaction in Grahame Park.

It is also interesting that this is lower for all areas than the level of agreement with the above statement relating to global scale. This would corroborate evidence from the interviews that the global dimension of air pollution as an issue has possibly greater salience for the respondents than the local aspect.

However the statement 'I think something needs to be done about air pollution in London' also had a high level of agreement, at mean 4.53 (s.e. 0.04) – agree to agree strongly. There was no variation in this according to area or other variables. This again is higher than the local aspect; it seems that people may experience air pollution as an issue in a wider geographical sphere than their residential locality. This also reflects perceptions of air quality in London as being particularly low, and lower than the local, as discussed earlier.

In terms of feelings of fatalism, acceptance or ability to do anything about the situation, three statements pertained to this. The first was 'I don't worry about air pollution because I can't do anything about it' (Q31d). The mean here was 2.25 (s.e. 0.08) – neutral to disagree, tending to disagree. Responses to this varied by area. The means were Totteridge 2.10, Hampstead 1.93, Brent Cross 2.50, Grahame Park 2.58; Hampstead was significantly lower than Grahame Park ($p = 0.019$).

Income also correlated negatively with agreement with this statement (Pearson's coefficient = 0.309, $p = 0.000$). This is a very significant, moderate effect: the higher the income, the stronger the level of disagreement with the statement. However it should be emphasised that the overall level was one of disagreement, generally.

The next statement was 'most people are too busy to worry about air pollution' (Q31e). Overall the mean score was 3.47 (s.e. 0.08) – neutral to agree. By area, Brent Cross appeared higher than all others but this did not reach significance using Tukey's test, although using the less conservative Least Significant Difference (LSD) test shows Brent Cross to be significantly higher than all other areas. The attitude attributed to others thus seems different from the attitude people claim for themselves; people assume a lower level of concern in the public in general.

The last statement of related interest was 'nothing can be done about air pollution' (Q31j). The mean rating here was 1.67 (s.e. 0.06) – disagree to disagree strongly. The means by area were Totteridge 1.5, Hampstead 1.51, Brent Cross 1.88 and Grahame Park 1.87. Due to significantly different variances these have to be tested for significant difference using the Tamhane's test which does not show a significant difference; however the tendency for Brent Cross and Grahame Park to be higher is noticeable.

Income correlated negatively with scores for this statement (coefficient = 0.243, p = 0.003), i.e. the higher the income the higher the level of disagreement with the statement tended to be.

4.6 CONCLUSIONS

People's perceptions of their local air quality correspond fairly well with the scientific estimates. People are to some extent realists: their perceptions are based largely on judgements regarding the physical levels, surmised by various means, which I will discuss further in chapter 6. Likewise their rating of air pollution as a problem in their area corresponds fairly well with its estimated level.

There are however some other effects. In terms of area context, air pollution does not come as a single issue. With traffic being the major source of pollution, air pollution is part of a cluster of problems suffered in living by a major road - problems including noise, congestion and accidents.

People's perceptions of air quality and its rating as a problem also seem to be influenced by other characteristics of the neighbourhood. In Totteridge for example, people cited the clean air in very positive terms, as one of the many positive attributes of the area. In Hampstead, the recognised badness of the air was confined to a very narrow geographical space, and the general level of happiness with the neighbourhood was reflected in feelings of the air quality as being otherwise good. In general it seemed that perceptions of poor air and rating it as a problem seemed to be in some part a reflection of a wider dissatisfaction with the physical and particularly social environment. This would agree with the more recent work of Irwin *et al.* (1999) and to some extent Bush *et al.* (2001a). However it is contrary to Smith *et al.* (1964) and Medalia *et al.* (1964) who concluded that concern arose out of satisfaction and attachment to the area.

At the same time, air pollution was relatively less important in the neighbourhoods where there were other problems, particularly Grahame Park where drugs and housing conditions for example were greater worries. This emerged in the survey and also was apparent in the interviews when questions about problems in the area drew no unprompted remarks about the air.

It is important however to balance this relative concern against absolute levels of concern. People in Brent Cross and Grahame Park in particular for instance did not necessarily feel that air quality is less important, they just had other things to worry about. This was reflected in the higher degree of fatalism apparent in both these areas, and the correlation of more fatalistic and disempowered attitudes with lower income levels. Poorer people and people in more deprived areas do not think air quality is less important, it seems, but they feel less able to do anything about it and they have other things to worry about. This is similar to the conclusions of Arsdol *et al.* (1964), Swan (1970), Kromm (1973) and

Bladan and Karan (1976). However, unlike these studies, the level of concern exhibited was not actually lower in the more deprived areas. Howell *et al.* (2002) however also found that people in a poor, polluted area showed high concern over air pollution, though they did worry about housing and crime more.

There seem therefore to be more than one level of operation, similar to the analysis of Whittaker (1998) in relation to perceived health risks in declining community, and also echoing Curtis (2004) – that multiple 'landscapes' of health my be overlain. On the one hand the environmental hazard – in this case air pollution – has a physical reality to which people respond. At the same time however, talk and feelings about air pollution can express satisfaction and dissatisfaction with the whole physical and social environment and can also be used in constructing an identity of place, for example in talk about Hampstead's healthiness – a therapeutic landscape - and in images of central London as a bad, dirty environment. Thus the material and symbolic operate simultaneously.

It is perhaps no surprise that the survey methodology tends to elicit responses which at least on the surface reflect more the operation of the realist mode, whilst the interviews better capture the more symbolic and metaphoric significances, although this is not exclusive. This is in part because the methodologies were developed largely with different models of what should be discovered, and so tend to fulfil this, i.e. they tend to constitute the view they give as well as revealing it; and partly because people respond differently to different methods. Here I would also corroborate Sale *et al.* (2002) from the discussion in Chapter 3, that mixing methodologies in this way should not be seen as simple triangulation, as they do not access the same phenomena, at least not completely.
Apart from the context of place, another context that appears very important is that of medical condition. People suffering from asthma, chest problems, heart disease, rhinitis type allergies and eczema seemed to perceive local air quality as worse and as more of a problem (though not all these conditions seemed salient all of the time) – see also Howell *et al.* (2002). This has implications for issues of equity, as discussed in chapter 2.

Other social variables in terms of socio-economic status, class or occupation seem less important in influencing perceptions except to the extent that they correspond with area of residence – this does not support the findings of many of the early survey studies (Smith *et al.* 1964; Medalia 1964; Kromm 1973, Zeidner and Schechter 1988).

In terms of the causes of air pollution, people very much felt that traffic was the greatest, which again would corroborate the scientific view. Buses and HGVs were seen as particularly polluting. Some people were worried about the contribution from air traffic, which is indeed an important issue. There was some indication that people travelling mainly by car might look for other sources to blame but at the same time they seemed to acknowledge car drivers' responsibility. However, better-off car drivers often partially exonerated themselves by pointing out that their cars were cleaner than others'.

Finally, the analysis so far does support the view that local context is important in perceptions of local air quality, but it does not support the view that the global context of air quality is of little relevance to people, as argued by Bush *et al.* (2002). Indeed the connections between air pollution and the global risks of climate change and ozone depletion were frequently made in the interviews, and concern over this scale was often expressed more strongly than concern over local air quality.

CHAPTER 5

The Impacts Of Air Pollution

In this chapter I want to discuss what participants in this study believed about the possible impacts of air pollution, and how they felt it affects themselves and those close to them. This includes general beliefs about how air pollution may affect health, how air pollution affects their own health, other effects of living with pollution, and any ways in which people make behavioural changes because of these impacts. Again, the role of context is addressed.

5.1 BELIEFS ABOUT THE HEALTH EFFECTS OF AIR POLLUTION IN GENERAL TERMS

Research participants had many beliefs about the ways in which air pollution could have health impacts on people in general. In the in-depth interviews, they were able to talk on this subject at some length, and the effects they discussed were reasonably wide ranging, varying from very specific complaints to more general health impacts.

In these interviews, by far the most prevalent theme in terms of these general health effects was respiratory problems. Asthma was the most referred to, but also discussed were bronchitis, occasionally emphysema, once cystic fibrosis; also often less specific chest and lung complaints, or a combination of general and specific.

Many people definitely felt that air pollution could cause the onset of these conditions:

> R What kind of illness do you think it might cause?
>
> Mrs Chan: Bronchitis I suppose. I always imagine all those, in the lung, all those spongy, sticky things, anything go in is not good. For everybody, not only, especially older ones, is not good.

Jean: bronchitis I would think.

Richard: Yes. Asthma.

R Do you think causing it, or just making it worse, or?

Jean: Both.

Jason: it's just not, I think, personally just mainly breathing problems, ... I mean it can give you, bronchitis, it can give you chronic asthma......it can give you cystic fibrosis. Loads of stuff that the pollution does to you.

However causation was often not expressed adamantly; often there was uncertainty expressed about causality, and alternative explanations were also offered.

Many of the remarks were around making existing conditions worse, again especially in terms of asthma and lung problems, for example that asthmatics in particular would suffer in poor quality air.

Erica: I'm sure that erm, there must be knowledge amongst, you know, people in this field, that er, leads them to know that bronchial, or asthma, er, people are very vulnerable, you know must be made worse rather than better to be in a heavily polluted area,

Nigel: I suppose it depends on the strength of the person doesn't it and how healthy they are, I imagine it would affect one of these who've got asthma or something like that,

Michelle: I suppose if you've got a bad chest or something like that, to inhale all that pollution is not very good.

Looking at asthma specifically, a recurring theme from the interviewees was the rise in the number of children with asthma in recent years. Mostly this was made first as a spontaneous observation:

Mrs Coates: And children now, more young children I see with puffers, ... whether it's because this is a recent thing, but they do use them more in primary schools now, because teachers are saying they don't want to be responsible for, you know...... but er, well according to research, asthma cases are increasing more and more.

Pauline: And the number of children who have puffers... which is a thing was unknown when I was a child. Now teachers have cupboardfuls.

Mrs Sharma: all the children like er, I teach in a school, I remember, in the 60s we didn't have that many children with asthmatic problems, and like in a whole school, there might be one or two, and now I go, in every class there are about 4 or 5 children and they all have to have their puffers at lunch time, the whole line of these children, they, more and more,

An association was definitely made between air pollution and increases in asthma, but there was a lot of uncertainty about causality. Some people did state fairly simply that air pollution could cause asthma, but often people talked of other possible causes as well, and their unsureness:

Mrs Sharma: I've seen it, like over the years, more and more children getting asthmatic, so I don't know where, I put it down to the pollution, and maybe perhaps smoke, the parents smoke more, but they did it in the 60s as well, so....

Phil: I don't know, it's, maybe it's pollution in general or maybe, maybe it's that we no longer have thirty kids, you know, I'm a great believer that when I was a young kid I was allowed to go out and get filthy, I used to play on the lorries at Kings Cross and go down to canal walk, you know, get a bit, and maybe my immune system is a lot stronger than a lot of kids ..

Mrs Coates: well according to research, asthma cases [in children] are increasing more and more.

R Would you attribute that to anything in particular?

B Well one would have thought pollution. Diet. We don't have a particularly healthy diet.

Julie: I think yes [air pollution] can hugely affect you, must be, loads of young people say under 8 who have er, inhalers now for asthma, which never used to be the case when my children were small thirty years ago, erm, but in a group of twenty say five of them can have an inhaler, so something [...].

R: what would you put that down to?

Julie: I don't have a broader knowledge of the subject, I don't know what [...] some say it's due to inoculation, or it is due to the environment around them, I don't know.

This uncertainty over whether or not poor air quality is responsible for these conditions echoes the interpretation of Moffatt *et al.* (1995) in their examination of lay understandings of the health effects of air pollution near a coking plant in north-east England. They found that concerns over respiratory disorders were strong, but that unease and worry were the predominant feelings, rather than conviction that pollution would be the cause.

Asthma and chest complaints were the kinds of conditions most talked about in the interviews with respect to how people's health might be affected by air pollution. Other kinds of conditions also arose several times, though less frequently. One idea that recurred was that air pollution could be cancer forming, again with various degrees of certainty:

Claire: I'm sure it's cancer forming, I'm sure it is, I'm sure, I'm not just saying that wildly, I'm sure it is,

Denise: all the what is it carcogenics [sic] that would be in the air or whatever, and maybe, that's one of the reasons why people, you know, start getting cancer and things like that, because they've never really proved, have they, Mr Walton: people walking past parked cars there pumping out the fumes, it's definitely going to affect their health. Anything that will create benzene [..], through chemical reaction is going to cause cancer in your body, so whatever you breathe in, you are, especially if sunlight is passing through it, you are going to breathe in the ingredient that will create cancer, you can't get away from it

Connected with the feeling that air pollution could be carcinogenic was a comparison with smoking that came up a few times as reasoning for how air pollution could be similar in its effects:

Denise: if you're breathing in a fume, it can't be very good for the body can it, it's like having a cigarette it's not really good for the body, it's the same sort of thing, so why should breathing in air pollution, fumes from cars, be any different?

Phil: That's right, you know, as a mother, presumably a mother who smokes, we know that a mother who smokes is more likely to have underweight children or children with this problem that problem, statistically we know that, but is there really that much difference between a cigarette, or, from breathing polluted air due to, due to traffic fumes? Presumably not.

Mr Robson: I don't smoke, I used to, but then I say to myself, what's the difference, I'm walking up the street there and I'm inhaling all that, lovely, the fumes and that, so, you know, that's always in the back of your mind, you go out here today you're going to walk up there and what's going to happen? You're breathing it in.

Another set of conditions that the interviewees talked about in connection with air pollution was allergies and irritations. This included hayfever, which in one sense could be seen as being because people included pollen among air pollutants. However this did not seem to be the only reason: people also felt that allergies such as hayfever could be made worse by being in an environment which was high in other air pollutants. I also realised from the interviews that people perhaps did not entirely separate out different allergen triggers, so for example often did not make a clear distinction between hayfever (pollen allergy) and allergic rhinitis from other causes, but focussed rather on the experience of the condition.

> Denise: erm yeah my sister, she suffers really badly, especially, since she's come to this country because she was living in Spain, she gets this sort of it's like a hayfever but it's not hayfever, they really can't pin it down so she's had you know those skin tests sort of thing, they say it a bit of pollen and a bit of dust but, sometimes it's absolutely awful.
> R So it's just, it's like, allergic rhinitis?
> M yes, that's right, yeah it is, yeah, and I think it's the pollution since she's been here. Yep.

> Viviane: it's certainly doing a lot of horrible things to my health, erm, I cough a lot.......sometimes erm, my eyes get irritated, erm, it's not something permanent but it comes and goes and there's nothing wrong with my eyes...

> Janet: my daughter has hayfever as well, and I just think oh god she's just going to aggravate it or something, she's going to continually have it, she's never going to be able to sort of erm, shake off the symptoms...

Skin complaints, including eczema, were also talked about – people speculating that air quality might make a difference to them:

> Kate: talking to my daughter about it because she's ten now and she's got a couple of little spots, erm, I know, I know it might not be exactly this, but when I, when I lived in London I always had bad skin, when I moved to Reading, I lived in Reading for 4 years, in sort of very woody sort of area, it was so clean, there were no cars, nothing you know it was really sort of in the middle of nowhere, and er, my skin was so clear,

> Sally: and I find the kids, they have eczema and things like that, you know I think that's from pollution and that, do you know what I mean, the way the skin is.

Problems to do with brain function or mental development also arose as a topic occasionally. This could have been to do with lead, and people making a connection with campaigning in the 80s for lead-free petrol, which brought it to public attention that lead can cause brain impairment in children.

> Denise: yeah, it can affect the memory, maybe it brings on, erm, is it Parkinson's, what's the one where you lose, you know you lose your memory and, the,
> R Alzheimer's?
> M Yeah. It's got lead, if people have got leaded fuel, lead, it's no good is it? It's the lead that can cause that, I think.

> Omar: I would imagine that for the very young children, infants, growing up, it might affect, I have no idea but as er, mmm.....in terms of general [...] I would tend to think it might have some, effect on their, development, the growth and development, er, physical, and intellectual, er, so their, IQ might be impaired slightly – it may not be noticeable, er, I don't know, I'm not saying that, there'd be a disaster there, but those babies or those children may not reach their potential, which they otherwise would have done,

Yet another complaint from the in-depth interviews was that pollution might cause tiredness and lethargy:

> Karen: you feel a bit more lethargic as well I think, I don't know whether that's just the stress of living in London or whether that is pollution,

> Mrs Coates: and of course you're sleepy, I find it quite dangerous when I'm driving, mmm ... I would think that, I'm always amazed that erm, lorry

> drivers aren't affected more – well they have respites don't they, have to have a rest every so often....

As well as the number of fairly specific complaints detailed above, a lot of the talk about the effects of air quality on people's health was unspecific and very general, a kind of 'generally bad for you' feeling. This was often associated with a sense of effects building up over time or being cumulative, but without the precise mechanism being clear.

> Mrs Kapoor: well I'm sure these thing are not good for the, your system, er, so some medical people can tell exactly which, but generally definitely not healthy for the... health.

> Karen: Well long-term health benefits I'm sure it affects them, erm..

> Len: Well, I think the truth is you won't know until you're dead! It possibly knocks a couple of years off your life compared to living in a place where the air's purer, one would suspect that, of course if you smoke or whatever that makes it ten times as bad, but clearly you do breathe in more rubbish into your lungs, living in the city,

> Dan: It's not something that happens at once you know, it takes, it's over a period of time, so it's kind of accumulative, you know, so, it may affect me, but because it's kind of accumulative, you know, I would never realise it now,

Another point was that air pollution might contribute to ill health or the development of certain conditions due to its being added to other factors. In this sense it was being seen as part of a whole, real life situation, rather than being separated out from other factors, as would be the aim of an epidemiological risk assessment:

> Jason: at the end of the day you could go into, move into London, thinking, oh, it won't really damage you that much, and ten years down the line, it's diagnosed with cancer. Maybe, it might not, because of, it might not be because that, living in central London, it could be other things, but,

Suzanne: But it doesn't help

Jason: it doesn't really help you. Say if you're a smoker, and you went to live in Liverpool, you might not get cancer, but, if you went to live in London where there's high pollution it could trigger it, just that extra added effect.

In the interviews, as explained above, people were expressing unsureness over whether air pollution could cause illnesses or would make existing illnesses worse. This is also an important issue in some of the scientific literature. To try and tease these apart therefore, in the questionnaire the two concepts were separated, and people were asked first whether they thought air pollution could cause particular illnesses, and later whether they thought it could make them worse (Q7 and Q8). The illnesses were those on a given list, rather than an open-ended question, but were taken from illnesses brought up in the interviews.

Responses as to whether air pollution could cause the listed health conditions were as follows, overall:

Table 5.1: Beliefs about air pollution causing certain health conditions

Condition	% respondents answering air pollution CAN cause it	% respondents answering air pollution CANNOT cause it	% respondents answering don't know
hayfever / sneezing allergies	89.5	3.0	6.0
other lung / chest problems	89.0	4.0	6.5
asthma	85.0	6.5	8.0
bronchitis	81.5	10.5	8.0
skin problems / eczema	63.0	14.5	21.0
cancer	42.0	19.0	38.0
heart disease	33.0	29.5	36.0
memory problems / Alzheimer's	19.5	32.0	47.5

As in the interviews, respiratory complaints featured highly in beliefs about what illnesses air pollution can cause. This corroborates the findings of Moffatt *et al.* (1995), Elliot *et al.* (1999) and Bickerstaff and Walker (1999a).

The uncertainty expressed in the interviews around causality was not reflected in the survey data. Even though 'don't know' was offered as a response, certainly with respect to the respiratory complaints including asthma, a high proportion of respondents answered a positive belief in the causal potential of air pollution exposure. Clearly the format of the questionnaire relative to the interviews is likely to affect this – in the questionnaire, people were given a choice of three bounded answers only, whereas in the interviews there was much more opportunity to express uncertainty and other possible explanations. Answering 'yes' to any of the above does not of course preclude a belief that other factors may predominate as causes of any of the conditions, as the interview data would indicate. The question was phrased as 'can cause' rather than 'does cause' which may also lead to higher responses and a tendency to answer 'yes' even if uncertain. Given the choice of three answers as well, people may answer 'yes' as a kind of precautionary approach, in order to register their worry.

Even given the above though it is noticeable that the degree of uncertainty around the respiratory complaints is much lower than that around cancer, heart disease and memory problems in particular, and also skin problems, so it would not appear to be only artefactual. People were willing to answer 'don't know' with respect to these other conditions. Belief that air pollution can cause respiratory complaints in people who do not already have them is apparently very strong. This is also true for allergies but some of this response may be due to people thinking of hayfever.

Having existing conditions was in some cases a predictor of people's belief in air pollution causing the listed conditions. Asthma sufferers were no different from non-asthma sufferers in their beliefs about causation. Heart problem sufferers were more likely than randomly expected to say air pollution causes heart disease ($X^2 = 5.53$, d.f. = 1, p = 0.019). Hayfever/rhinitis sufferers were more likely to say air pollution can cause asthma ($X^2 = 5.637$, d.f. = 1, p = 0.018) and to say it can cause hayfever/rhinitis ($X^2 = 5.319$, d.f. = 1, p = 0.021). Eczema sufferers were more likely to say air pollution can cause asthma ($X^2 = 7.296$, d.f. = 1, p = 0.007) and that it causes eczema or skin problems ($X^2 = 6.715$, d.f. = 1, p = 0.010).

People with children under 16 were more likely to say that air pollution can cause eczema ($X^2 = 8.619$, d.f. = 1, p = 0.003). This is not surprising as the incidence of eczema has risen in children in recent years (Wadonda-Kabondo *et al.* 2003).

There were no significant associations with which area people lived in and whether they thought air pollution could cause any of the illnesses.

To ask about how people thought air pollution could worsen existing health conditions, in the survey they were given the same list of conditions as for the causation questions and asked to rate on a five point scale how much they thought each of the problems could be affected, where 1 = no effect and 5 = a very big effect. The mean values for the whole sample were as follows:

Table 5.2: Mean ratings of how much air pollution can affect certain conditions

Condition	N statistic	Mean	St. error
Asthma	192	4.41	0.06
Hayfever	188	4.31	0.07
Other lung / chest problems	187	4.29	0.07
Bronchitis	189	4.22	0.07
Eczema	154	3.45	0.11
Cancer	127	2.87	0.12
Heart disease	138	2.83	0.12
Memory problems / Alzheimer's	110	2.19	0.13

The question offered a 'don't know' option, so the N statistic subtracted from 200 (200 being the total number in the sample) gives the number of people either answering 'don't know' or not answering the question at all.

Respiratory disorders and allergies were thought to be the worst affected, and with the least uncertainty – reflected in the number of people answering, and in the smaller standard errors. Over 4 corresponds to between 'a quite large effect' and 'a very large effect' on the answer scale.

Asthma sufferers had raised perceptions of effects on asthma (4.74 c.f. 4.34 for non sufferers, $t = 3.539$, d.f. = 77.9, $p = 0.001$), on bronchitis (4.65 c.f. 4.13, $t = 3.977$, d.f. = 79.4, $p = 0.000$), on other chest problems (4.67 c.f. 4.22, $t = 3.007$, d.f. = 55.4, $p = 0.004$) and on hayfever (4.73 c.f. 4.24, $t = 4.050$, d.f. = 90.4, $p = 0.000$). Eczema sufferers had a raised perception of the effect of air pollution on asthma (4.66 c.f. 4.36, $t = 2.348$, d.f. = 62.9, $p = 0.022$), on bronchitis (4.53 c.f. 4.16, $t = 2.082$, d.f. = 186, $p = 0.039$), on cancer (3.46 c.f. 2.74, $t = 2.486$, d.f. = 124, $p = 0.014$), on hayfever (4.88 c.f. 4.21, $t = 6.263$, d.f. = 118.9, $p = 0.000$) and on eczema (4.16 c.f. 3.28, $t = 3.473$, d.f. = 151, $p = 0.001$).

Gender made some difference – women rated air pollution as having a bigger effect on asthma (f 4.55, m 4.25, $t = 2.493$, d.f. = 187, $p = 0.014$) and on eczema (f 3.72, m 3.07, $t = 3.209$, d.f. = 144, $p = 0.002$). This could be due to these conditions being more likely to affect children; even though having children under 16 did not affect this rating, it might be that women would be more likely to notice, or be more concerned with, the effect on children (Davidson and Freudenberg 1996).

Older people seemed to think air pollution had less of an effect – age correlated negatively with level of effect on asthma (coefficient –0.170, $p = 0.018$), on hayfever (-0.168, $p = 0.021$) and on eczema (-0.256, $p = 0.001$). This may reflect the greater prevalence of these disorders in younger age cohorts.

Again, area did not make a difference to these ratings. Beliefs in the effects of air pollution on people in general seemed not to be affected by the level of residential pollution suffered personally. Neither were they affected by income, education, or newspaper readership. The amount of TV watched did correlate significantly and positively, but weakly, with rated effect of air pollution on heart disease (coefficient = 0.174, $p = 0.042$) and on cancer (coefficient = 0.181, $p = 0.043$) but not on any of the other conditions.

5.2 THE PERCEIVED HEALTH EFFECTS OF AIR POLLUTION ON THE PARTICIPANTS AND THEIR FAMILIES

In the in-depth interviews, the majority of talk about the health effects of air pollution centred around its effects in general terms, i.e. how it might affect people in general as discussed above. There was however talk about how air pollution affected the interviewees themselves and people close to them.

In terms of specific complaints, it was mainly the asthma and allergy sufferers who felt affected personally. They often felt that air pollution could be a trigger to attacks, or an extra irritant:

> Janet: it affects me, I'm actually affected quite, in summer, mainly in summer I'm affected, when it gets, when it's very warm, I tend to have, my throat, and my nose gets all blocked up. I think I'm slightly, erm, slight allergy, hayfever type thing, yeah. And you can notice, the symptoms get worse when you're, you know [in a place where there is poor air].

> Caroline: Oh, breathing, I mean I have to watch myself anyway when I'm sort of like, even here cos, if I exert myself then I get like short of breath and ... like that, but, the pollution is a definite, it sort of, aggravates it sort of like immediately, if I'm put in to that, sort of, what's the word I'm looking for, vicinity or area.

> Mrs Sharma: when I first came to this country, I didn't have any, allergy problems, but er, then over the years now I developed bronchitis and er every time now if in winter time I get a cold or something and it doesn't get better quickly, it turns into, chest and then the doctor he gives me a puffer every time now he says you're asthmatic....

Other personal health effects that were brought up included irritations of the skin, mentioned above, coughing, eye and ear complaints. None of these were a particularly recurrent theme and often, though not always, they were talked of with uncertainty as to whether pollution might or might not be a contributing factor.

> Karen: I do notice that we get a lot of colds, and, erm, coughs and things like that, erm, whether that's because we've got a young child and they pick up every bug or whether that is pollution, but in London certainly,

> Erica: well, I'm lucky enough not to suffer from any kind of chest problems at all myself, erm, whether or not erm, you know air pollution affects skin, which I do have a problem with, erm, and I don't know whether that has anything, er, indirectly, or directly to do with the air that I'm breathing

Otherwise, quite often people talked of the general feeling that pollution might not be doing them much good, or that they disliked breathing in fumes in a short-term sense.

> Mrs Coates: I worked in Somerstown doing the [..] work, and I used to feel quite poorly most of the time, and I thought it was pollution.

It was noticeable that most of the effects were not talked of in terms of being connected to their area of residence. On the whole, people were talking about feeling the effects in different places where they went in their day-to-day lives, including local shopping areas and central London, or else they were talking about the medium to long term effect of living in London in general.

As such, there were few differences in the way personal health effects were talked about between the different areas, except that there was a little more said about effects in Hampstead and perhaps Brent Cross, although this was not always attributed directly to the local roads and also again there was uncertainty.

> Siobhan (Hampstead): I think, even here I would say I probably if I get a cold I will definitely get a cough which I never used to get and I think that's probably something to do with the air...

Viviane (Hampstead): it's certainly doing a lot of horrible things to my health, erm, I cough a lot,......sometimes erm, my eyes get irritated, erm, it's not something permanent but it comes and goes and there's nothing wrong with my eyes,

Julie (Brent Cross): it doesn't affect my chest or anything like that, but, you know as far as erm, being exact about it ....obviously the traffic must be a health hazard, you know,

Pam (Brent Cross): I don't really know. As I said I can smell it sometimes it catches my throat, but to be honest I don't really know whether or not, because I'm quite, thank God, healthy.

One factor that complicated the situation in Brent Cross was that more of the respondents were smokers, and although some had chest problems, they felt less justified in complaining about poor air quality, or were less likely to make attributions to the air pollution as it was more problematic to do so:

Pauline: well if I've got anything wrong with my lungs it will aggravate it. It must do. Must do.
...later... I have had......... tests at the Royal Free, and I have lost part of the use of my lungs, but that, presumably is due to A old age and B smoking.

Also
Pauline: and my mother died of lung cancer, I know she smoked, my father did..
R: Did they live here?
Pauline: yes, and I sometimes put it down – I know smoking is a cause of a lot, but I do think pollution helps.

In the survey, respondents were asked to rate the importance of their everyday air quality to their health personally, on a 5 point scale (question 10). The mean rating overall was 4.34 (s.e. 0.06) – between very important and essential. There were no significant differences between the 4 areas in responses to this question, again suggesting that experience of air quality and health is not located in one place.

The mean response to question 10 above was slightly but just significantly lower than the answer to the previous question, 'how important do you think everyday air quality is for the health of people in general' – overall mean 4.48 (s.e. 0.05). People on average in all areas thought themselves slightly less vulnerable than people in general. This was similar to the findings of Moffatt *et al.* (1995) and Bickerstaff and Walker (1999a), who also found that people tended to attribute greater vulnerability to the population as a whole, and / or to people around them. Some have attributed this to denial (Bickerstaff and Walker 1999a, 2001) or optimistic bias.

Somewhat surprisingly, people with asthma, chest problems and heart disease did not feel that air quality was any more important to their health than did non-sufferers. However those with hayfever/rhinitis did (4.63 c.f. 4.23, $t = 3.745$, d.f. = 150.1, $p = 0.000$). This may reflect the fact that some people included pollen in their list of problem air pollutants, but as I mentioned earlier, this should not be assumed, as from the interviews it appeared that people with allergies sometimes thought that air pollutants apart from pollen made their allergies worse, and indeed this would be backed up by some medical studies mentioned in chapter 1 (e.g. Diaz-Sanchez *et al.* 2000; Knox *et al.* 1997; Behrendt *et al.* 1997).

Car users felt that air quality was significantly more important to their health than did non car users (mean 4.5 c.f. 4.25, $t = 2.025$, d.f. = 191, $p = 0.044$). This may be connected with car drivers talking about noticing traffic fumes while they are driving, and indeed other evidence is that the dosage of air pollution received can be higher for people inside vehicles on busy roads than for pedestrians (Chan *et al.* 1991; Rank *et al.* 2001).

Performing a multiple regression modelling this variable against the possible predictors above showed that when controlling for each of the other variables, rating the importance of everyday air quality for health is related to having hayfever/rhinitis only, and no longer to car driving. Area of residence is still not a significant predictor. The R Square value for this model is however very low, showing that very little variance is explained by these explanatory variables.

Table 5.3: Multiple regression modelling how important people feel everyday air quality is for their health

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	4.164	0.186	-	22.393	0.000
	age	0.010	0.035	0.020	0.282	0.778
	gender	0.241	0.119	0.147	2.029	0.044
2	(Constant)	4.095	0.209	-	19.567	0.000
	age	0.018	0.036	0.037	0.511	0.610
	gender	0.245	0.120	0.149	2.046	0.042
	HGS	0.195	0.160	0.108	1.220	0.224
	GPK	-0.058	0.159	-0.032	-0.367	0.714
	BX	-0.050	0.183	-0.023	-0.270	0.787
3	(Constant)	3.833	0.227	-	16.887	0.000
	age	0.041	0.038	0.084	1.074	0.284
	gender	0.233	0.121	0.142	1.921	0.056
	HGS	0.090	0.160	0.050	0.562	0.575
	GPK	-0.105	0.159	-0.058	-0.659	0.511
	BX	-0.115	0.184	-0.053	-0.626	0.532
	asthma	0.018	0.159	0.009	0.116	0.908
	chestprob	0.055	0.207	0.019	0.266	0.790
	heartprob	0.221	0.227	0.076	0.971	0.333
	hayfever	0.330	0.137	0.185	2.413	0.017
	eczema	0.207	0.165	0.097	1.255	0.211
	car user	0.170	0.129	0.100	1.322	0.188

Tables 5.4-5.5: Multiple regression modelling how important people feel everyday air quality is for their health

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.721	2	1.361	2.079	0.128
	Residual	122.353	187	0.654		
	Total	125.074	189			
2	Regression	4.797	5	0.959	1.468	0.202
	Residual	120.277	184	0.654		
	Total	125.074	189			
3	Regression	13.637	11	1.240	1.980	0.033
	Residual	111.437	178	0.626		
	Total	125.074	189			

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.147(a)	0.022	0.011	0.809
2	0.196(b)	0.038	0.012	0.809
3	0.330(c)	0.109	0.054	0.791

To investigate more perceived personal effects in the survey, people were asked, "do you, or have you ever, suffered from any illness or health problem you think was *caused* by air pollution?" (Q11a).

Overall, 28% of respondents said yes, they had, 53% said no, and 16% answered 'don't know'. There were no significant differences in the 4 areas, despite people's ratings of local air quality as different. As discussed above with respect to the interviews, this suggests that people's experience of air quality and how it affects them is not confined to the locality of where they live, but incorporates much wider experience, particularly for instance if they work in central London.

Asthma sufferers were much more likely to answer 'yes' to this question and much less likely 'no', (X^2 = 20.140, d.f. = 1, p = 0.000). People with chest problems were more likely to answer 'yes' (X^2 = 6.595, d.f. = 1, p = 0.010), hayfever/rhinitis sufferers were much more likely to say 'yes' ($X^2 = 20.998$, d.f. = 1, p = 0.000), as were eczema sufferers ($X^2 = 6.978$, d.f. = 1, p = 0.008). Other variables were not connected with responses to this question.

A binary logistic regression modelling this variable (coded as 'yes' against 'no'/'don't know') shows significant associations with asthma, chest problems and hayfever only – not eczema, when controlling for the other health issues, and again, not area of residence.

Tables 5.6-5.8: Multiple binary logistic regression modelling whether people believe they have a health problem caused by air pollution

		B	S.E.	Wald	Df	Sig.	Exp(B)
Step 1	Age	-0.165	0.124	1.753	1	0.185	0.848
	Gender	0.471	0.399	1.394	1	0.238	1.601
	HGS	-0.004	0.513	0.000	1	0.993	0.996
	GPK	-0.271	0.527	0.264	1	0.607	0.763
	BX	0.252	0.570	0.196	1	0.658	1.287
	Asthma	1.679	0.471	12.687	1	0.000	5.358
	Chestprob	1.343	0.646	4.320	1	0.038	3.832
	Heartprob	1.102	0.680	2.625	1	0.105	3.009
	Hayfever	1.286	0.397	10.517	1	0.001	3.620
	Eczema	0.165	0.499	0.110	1	0.740	1.180
	Constant	-1.507	0.691	4.749	1	0.029	0.222

Step		Chi-square	df	Sig.
1	Model	44.706	10	.000

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	182.111	.210	.301

Having been asked whether they had ever suffered from an illness or health problem caused by air pollution, those who had answered yes were asked what it was. This was an open question and more than one response was allowed. Responses were categorised post hoc. 56 people answered with a total of 73 responses, as follows:

Table 5.9: Numbers of respondents believing they have certain health conditions caused by air pollution

Condition	No. people
hayfever, rhinitis or similar	26
asthma	20
other/unspecified chest/ breathing problem	16
skin problem, including eczema	4
tiredness	2
nausea	2
sore throat/ throat infection	2
eye irritation	1

Again the complaints were noticeably dominated by respiratory and allergic conditions. This reflects the findings of Bickerstaff and Walker (1999a) in Birmingham, who found that asthma, other chest complaints and allergies were the most cited conditions attributed to air pollution in their survey. Moffatt *et al.* (1995) and Elliot *et al.* (1999) also found that respiratory health was the greatest concern of people suffering air pollution, although the nature of the pollution in their studies was largely industrial rather than traffic-related.

People were next asked, "do you, or have you ever, suffered from any health problem or illness that you think is made worse by air pollution?" (Q12a). Overall, 36.5% answered 'yes', 47% answered 'no' and 14.5% answered 'don't know'. Again there was no significant difference in these percentages between the 4 areas.

Asthma sufferers were much more likely than expected to say 'yes' and much less likely to say 'no' to this question (X^2 = 29.019, d.f. = 1, p = 0.000); as were sufferers from chest problems (X^2 = 6.006, d.f. = 1, p = 0.014), hayfever/rhinitis sufferers (X^2 = 37.290, d.f. = 1, p = 0.000) and eczema sufferers (X^2 = 13.272, d.f. = 1, p = 0.000). Having heart disease interestingly was not associated with people being significantly more likely to say yes, even though the current medical evidence is that heart conditions are among those potentially most affected by air pollution (Department of Health 1998; 2000).

A binary logistic regression performed as above again showed that positive responses to this were again associated with having asthma (OR = 8.263, p = 0.000), chest problems (OR

= 4.437, p = 0.021) and hayfever (OR = 7.3, p = 0.000) but not eczema and still not area of residence, when controlling for the other variables. (Nagelkerke RSq = 0.421, overall model p = 0.000).

Those who answered 'yes' were asked what the problem was, in an open ended question where more than one response was allowed. Answers were coded post hoc. 72 people answered with a total of 85 responses, categorised as follows:

Table 5.10: Numbers of respondents believing they have certain health conditions made worse by air pollution

Condition	No. people
hayfever, rhinitis or similar	29
asthma	26
other/unspecified chest/ breathing problem	18
skin problem, including eczema	6
cancer	2
heart disease	2
general allergies	1
M.E.	1

Again, allergies, asthma and chest problems predominated. They were also asked how much they think air pollution affects this problem, on a five point scale, and the mean answer was 3.96 (s.e. 0.08) which corresponded to 'a quite big effect'.

Survey respondents were then asked, 'Do you think air pollution affects the health of any of your family or friends?'. Overall, 57% answered 'yes', 20% 'no', and 18.5% 'don't know'. There were no significant differences in this between areas. This was higher than the number of people claiming to be personally affected, a pattern also found by Moffatt *et al.* (1995).

People with children under 16 were more likely to answer 'yes' to this question and less likely 'no' or 'don't know' (X^2 = 7.656, d.f. = 1, p = 0.006). It seems likely that this would be connected with a greater incidence of conditions such as asthma, allergies and eczema in children. Elliot *et al.* (1999) also found that health concerns over pollution were greater in people with children.

Respondents who had answered 'yes' to this question, as before were asked in an open-ended manner how their family or friends were affected. 104 people answered with a total of 152 responses, categorised post hoc as follows:

Table 5.11: Numbers of respondents believing the health of their family and friends is affected in certain ways by air pollution

Condition	No. people
Asthma	61
Hayfever, rhinitis or similar	33
other/unspecified chest/ breathing problem	30
skin problem, including eczema	14
Eye irritation	4
Heart disease	3
General allergies	2
cancer	2
Irritability, bad mood	1
Autism	1
Impaired immune system	1

Clearly, as before the responses cluster around asthma and respiratory problems, with skin problems occurring the next most frequently. A clear lay epidemiology seems to be emerging. Even given the possibility of suggestion by earlier questions in the questionnaire, the beliefs seems fairly strong and consistent, as heart disease for instance was suggested just as much in the questionnaire and did not emerge as a particular concern. As well as concerns concentrating on these kinds of disorders, as in the interviews concern over a range of conditions were raised in the survey, including immune problems, developmental problems and more general well-being.

5.3 EXPERIENCING THE NON-HEALTH-RELATED IMPACTS OF AIR POLLUTION

Survey respondents were asked, in an open-ended question, 'does air pollution affect you in any other way apart from your health?' (Q14).

Overall, 47 people answered – 23.5% of the sample. This was substantially lower than the number of people claiming to feel health-related effects. Bickerstaff and Walker (1999a) also found that direct health impacts were the greatest pollution-related concern of their respondents. There was a difference across the areas ($X^2 = 13.506$, d.f. = 3, $p = 0.004$): in Hampstead Garden Suburb many more people than expected said they did suffer non-health effects, while in Grahame Park, rather less than expected did. Brent Cross and Totteridge were as expected in a random distribution.

From the 47 people there were a total of 58 categorised responses, as follows:

Table 5.12: Numbers of respondents feeling various non-health impacts of air pollution

Effect	No. people
outside of house/ windows dirty	12
mood/ quality of life affected	10
dust and dirt inside house	8
person dirty (including inside nose)	7
bad smell	5
clothes dirty	4
noise	4
enjoyment of outdoors affected	3
can't open windows	2
food affected	2
climate change	1

The more specific complaints centre largely on dirt in various places. It is interesting that many of them are to do with quality of life and well-being, although not thought of as strictly health complaints.

In the interviews there was a noticeable difference in the different areas – in both Hampstead Garden Suburb and in Brent Cross, there was much more said about non-health effects of pollution than in Totteridge or Grahame Park, and in these two places they very much centred around dust and dirt:

> Mr Farnham, (Hampstead): it's on all the window shelves, up on this one here where we do occasionally open the window, but where you mostly see it is in the loft, and it just comes in under the tiles, you can't put anything in the loft and it not get covered in grit and black

> Viviane (Hampstead): and my house is so dusty, all the time, and erm, it's very difficult to clean it and get it dust free, because of this main road

> Sally (Brent Cross): the volume of cleaning you've go to do in the flat, because of the dust, it gets in everywhere......I mean you've got to do it, I can wash the floor twice a day

> Leslie (Brent Cross): I know this from my balcony outside here, once a week I have to sweep it because there's about an eighth of an inch of black dust which forms on it so that obviously comes from, peoples exhaust fumes and everything.

In Grahame Park, the one person who complained about dirt in the house from air pollution was the woman who lived on the side closest to the motorway. In Totteridge, relevant comments were few and not to do with the neighbourhood; one person talked about worries about how animals near motorways were affected.

Clearly the non-health effects of air pollution are mainly related to the physical, visible dirt and dust. This dust is the visible particulate air pollution and it is this that people respond to most in this sense. However, overall well-being was another quite high concern.

5.4 ACTIONS TAKEN BECAUSE OF AIR POLLUTION

In the interviews, I was interested in whether or not people took any actions in order to cope with air pollution, or changed their behaviour in any way if air quality was poor. Over the course of these interviews, quite a few ways of adapting to poor air quality emerged. Some of these took place where they lived, but others were to do with wherever pollution might be encountered.

Avoidant behaviour was common. Some people said they avoided polluted areas and roads:

> Kate: I just wouldn't go to that particular place, I'd avoid it, like I never go down the West End now, because I just think it's filthy down there, I rarely ever go to Camden Town now unless I absolutely have to, I used to quite like going down there but now I just find it really, horrible, so I just avoid, because I couldn't be one of those people who has one of those things over their mouths

> Caroline: when I was working, I never used to walk down Oxford Street, I always used to go the back roads to work, never actually down Oxford Street to get where, cos it was too, you know.

Some people said they would hold their breath if passing a particular source:

> Denise: if I was to smell a fume I'd probably hold my breath until the car went or until the smell went somehow, I'd do it. It's just one of those normal things to me.

> Caroline: I've often been sort of like pushing the buggy and holding my breath 'til I get past the offending area

A few respondents would avoid going out altogether when they thought pollution levels were high, but this was less common and mainly people who felt physically affected, as other people in fact expressed that this was not a practical option.

> Janet: yeah you do, tend not to want to go out on those days, [when pollution is bad] especially if you're being affected ......if they say it's going to be bad, erm, I might reschedule things if I can.

> Mrs Sharma: I just try not to go out much [when pollution is bad], yeah because like I do go for a walk, sometimes in the evenings and all that, and if I just go, into the car park and I feel the stench, or if I'm coming from outside, and I feel it, I just come in and I shut the windows, and I stay indoors.

In terms of actions taken at home, keeping windows closed seemed a fairly common precaution:

> Mr Farnham: we don't open the windows on the front and we try not to open them on the side, erm, so that it goes past us, we open the windows on the back, er, and then the pollution just doesn't come in.

> Mrs Chan: for instance daytime, even though we don't have many cars, normally I open the back garden windows, back side, and at night I open both sides, I do a very simple cost free method.

Some respondents in Brent Cross said they didn't hang washing out – this was not said in other areas where the air was cleaner or they had gardens.

> Pauline: You really can't hang your washing outside, so you use a tumble dryer instead

> Nigel: you can't hang your washing out on that road because you just get all traffic dust on it

Something brought up by car drivers who often noticed pollution whilst driving, was that they would regulate the air inside their cars to avoid the exhausts from other traffic

> Denise: even when I'm in the car, you know they've got like these two things where you can get the air from inside the car and the air from outside, I never have it from outside, ever, always in.

A quite surprising aspect relating to cars was that although some people said they did not want to drive as this would worsen pollution, it was apparent that to some, their car could be seen as a protection from the pollution outside, and so perceived pollution or a bad environment might encourage them to drive:

> Caroline: there's a high percentage of cars and that's one reason why I won't drive, I don't drive myself, although I have passed my test, I've never had a car. Erm, because I don't want to add to it, that's how strongly [I feel].

> Kate: it's good to walk, you know and it is quite a pleasant walk, I don't think I'd feel the same if it was a built-up horrible area, I probably would drive. Because I wouldn't want to breathe it in, I could be sitting in my car.

This latter point is counter-intuitive to the physical evidence that the dosage of pollution received from sitting inside vehicles can be higher than that received from walking by the road (Chan *et al.* 1991; Rank *et al.* 2001). Car drivers felt that they could regulate the environment inside the car and so it was better, or at least more under their control.

Complaining to authorities or asking for something to be done was not a popular option. Most interviewees thought that this would not achieve anything:

> Denise: I wouldn't just phone up Barnet council maybe and say you know, oh the air pollution there is bad, well I don't think it is. But if there was a council set-up or a sort of a, you know forum I'd go to that and speak my mind, mm.

> Erica: I hadn't thought of campaigning, I mean what can one do, can one campaign?

> Omar: so what one does about it I don't know, I have refrained from er, chasing the council to come up with solutions

Many people in the end expressed fatalism, or a belief that they couldn't do anything. As discussed in chapter 4, this was an attitude that tended to be more common in the poorer areas:

> Richard: (Totteridge) I wouldn't have thought there was anything you could do about it, would you?

> Janet (Brent Cross): I try not to think about it [laughs] I've got enough things to worry about day to day, you don't sort of want to dwell on those things

> Nigel (Brent Cross): don't really take much notice of it, you know it's only because it's been mentioned, but otherwise you know treat it as, it's just a part of life sort of thing, you just accept that it's there and that's it

> Michelle (Grahame Park): I suppose everybody cope with things like that in their own sort of way. I don't think, whatever, if the airs like that anyway it's like that, there's nothing really you can do about it is there?

To follow up the theme of adaptive behaviour in the survey, respondents were given a list of possible actions that might be taken due to air pollution, and asked how often they would do that due to air pollution (Q15). The list was compiled from actions that had been talked about in the interviews. Answers were on a 5 point scale ranging from 'never' (1) to 'always' (5). Overall, the mean scores were as follows (bold indicates significantly higher and lower groups):

Table 5.13: Mean frequencies of various actions taken due to air pollution

Action	Mean	Std. Error
Keep windows closed	**2.32**	**.08**
Take medication e.g. antihistamines, inhaler	2.05	.10
Don't hang washing out	1.92	.09
Drive rather than walk	1.85	.09
Avoid main roads	1.84	.08
Avoid going out	**1.36**	**.05**
Complain to council or other	**1.26**	**.05**
Wear a mask	**1.14**	**.04**

Keeping windows closed was significantly higher than all other actions apart from taking medication. Avoiding going out, complaining and wearing a mask were significantly lower than all others. None of the actions were particularly frequent however, the highest score being 2.32 for keeping windows closed, which corresponded to between 'occasionally' and 'sometimes'. The middle group scored around 1, corresponding to 'occasionally', and the lower three were between 'never' and 'occasionally'.

Keeping windows closed had been shown to be one of the most frequent ways of coping with pollution in several previous studies (Zeidner and Schechter 1988, Wall 1973, Kromm 1973, Elliot *et al.* 1999), as had not hanging out washing, which was a little less popular here (Kromm 1973, Wall 1973, Elliot *et al.* 1973). Most previous studies had however shown, as in this study, that these types of small behavioural changes were more common than complaining to authorities (Wall 1973, Zeidner and Schechter 1988, Elliot *et al.* 1999).

There were a couple of differences between study areas in frequencies of actions taken. Those in Hampstead kept their windows closed most, and significantly more than those in Totteridge who did least (means 2.71 c.f. 1.96, Tamhames test $p = 0.003$). Surprisingly, those in Grahame Park said they avoided hanging washing out the most (mean 2.22), significantly more than Totteridge (mean 1.59, Tamhames $p = 0.021$).

The most differences in behaviour were by people with medical conditions. The following are significant differences between those with and without the conditions listed in Q46a, tested using a t-test.

Table 5.14: Differences between mean frequencies of actions taken due to air pollution for respondents with and without asthma

Action	Mean asthma	Mean no asthma	t	d.f.	p
avoid going out	1.67	1.29	2.220	37.95	0.032
keep windows closed	2.70	2.24	2.153	191	0.033
take medication	3.57	1.71	8.297	190	0.000
avoid hanging washing out	2.43	1.81	2.236	42.5	0.031
drive rather than walk	2.43	1.73	2.581	42.7	0.013

Those with asthma (above) took most actions more frequently, but did not complain more and did not avoid main roads more.

Table 5.15: Differences between mean frequencies of actions taken due to air pollution for respondents with and without other chest problems

Action	Mean chest probs	Mean no chest probs	t	d.f.	p
avoid going out	1.69	1.33	2.026	191	0.044
take medication	3.24	1.94	3.790	190	0.000
drive rather than walk	2.44	1.80	1.993	190	0.048

Table 5.16: Differences between mean frequencies of actions taken due to air pollution for respondents with and without hayfever/ rhinitis

Action	Mean hayfever/ rhinitis	Mean no hayfever/ rhinitis	t	d.f.	p
keep windows closed	2.67	2.17	2.827	191	0.005
take medication	2.84	1.72	5.473	190	0.000
complain	1.47	1.18	2.199	68.3	0.031
drive rather than walk	2.14	1.73	1.946	89.2	0.055

Table 5.17: Differences between mean frequencies of actions taken due to air pollution for respondents with and without eczema

Action	Mean eczema	Mean no eczema	t	d.f.	p
take medication	2.79	1.89	3.154	43.7	0.003
complain	1.59	1.20	2.120	37	0.041
drive rather than walk	2.32	1.75	1.988	40.3	0.054

Having heart problems was not associated with taking any of the actions more frequently.

Of course these associations are not necessarily independently causal and in the case for instance of eczema, many of the eczema sufferers also suffer from asthma and other allergic reactions which may be more pertinent with regard to their actions.

Having children under 16 also made a difference to taking actions:

Table 5.18: Differences between mean frequencies of actions taken due to air pollution for respondents with and without children under 16

Action	Mean children	Mean no children	t	d.f.	p
complain	1.42	1.19	1.979	95	0.051
avoid main roads	2.27	1.63	3.767	110.6	0.000

This strong tendency for people with children to avoid main roads reflects something that came up in the interviews, with many women in particular talking about air pollution being bad for young children, particularly those in pushchairs which put them at the height of vehicle exhausts:

> Claire: certainly I suppose if I er had small children in a buggy, I wouldn't pull them along a main road, I would consciously avoid wheeling them along a main road, er, full stop, full stop.

> Maria: I remember when I was pregnant when I used to go past cars belching out and I walked past like this [holding hand over mouth] because that, when

> you're pregnant you're so protective of the, - hold my breath and probably the lack of oxygen was doing more harm to the baby than breathing in the fumes, but I was aware of it then, if I crossed behind a car, or when the babies were little, if I crossed behind a big, you know, cars, or, that sort of thing

Overall, the types of actions taken to cope with poor air quality emerged as very similar to those found in previous studies (Kromm 1973, Wall 1973, Zeidner and Schechter 1988, Elliot *et al.* 1999), particularly keeping windows closed and not hanging out washing, although staying indoors was less popular than in some previous studies (Wall 1973).

5.5 EFFECTS IN CONTEXT

It became very apparent from the interviews that the experience of the neighbourhood as a whole acted to affect the way in which impacts of air quality or the main road were felt. A comparison between Brent Cross and Hampstead illustrates this.

In Hampstead, the neighbourhood was seen as very desirable, and residents had made a positive choice to live there for many reasons, which included the good schools, and in particular, aspects of the physical environment. They recognised that the main road was a negative aspect but this was balanced against the other positive aspects (See also Elliot *et al.* 1999). In particular several interviewees mentioned that it was an economic choice – that accepting living by the main road meant that they could afford to live in Hampstead Garden Suburb, whilst otherwise they could not. Thus the impacts were suffered willingly, as a positive choice:

> Omar: basically why am I here, because it's pleasant because there are these parks, open spaces surround, it's, contiguous with other pleasant areas, going towards erm, regents park etc, they're all, er, sort of better off or safer areas, safe also from a physical point of view, security point of view, I think it's more secure than lots of other areas,

> Mrs Kapoor: yes, but one thing, you can't have everything, to get more thing, you compromise with another, ...when I get so much nice thing........yes obviously pollution there, if no pollution the house prices would triple, but because it's main road, slightly less than the inner one, smaller [house] than this one inside [the Suburb] would be another sixty thousand more, so it's you know, one's related to another.
>
> Elaine: Well that's why we moved here actually because this house, in a bit [towards the centre of the Suburb] would be, would have been a lot more [expensive]. Erm, yes."
>
> Len: But it's a fact of life in the city, if you don't like it, one can always relocate.

Whereas in Brent Cross, on the council estate, people had less choice, even though many of them liked it well enough:

> Nigel: well I'm it not in a particularly strong position to move anyway so it's a case of.. although I like it, I'm not saying, but even if I didn't I would have to stay here anyway because I'm not, financially well enough to sort of, afford to buy my own place, you know.

So feeling the power to make a choice was one way by which the impacts were in a sense lessened, or not experienced the same in different places. This is also pointed out by Bickerstaff and Walker (2001); they see choice to live in a place as a reason for people to see it as better, and possibly deny the negative aspects.

However I would argue that the physical environment of Hampstead as opposed to Brent Cross meant that people actually suffered the impacts less in physical terms, as well as psychological terms. Strictly speaking the air quality is, according to scientific data, very poor immediately where they live, but the neighbourhood as a whole has a lot of greenery and open space, and is pleasant, quiet and safe. Crucially the houses also have gardens which give the residents an immediate retreat even in their own home. Thus they were still able to feel that their environment was good and healthy:

> Karen: I mean you've got the main road so I'd say, in terms of pollution and so on then that, [...], but you sort of mask that fact because you've got a nice garden and... you forget that you've got juggernauts going down the road, because you've got a nice garden and park and so on....

> Omar: this is the old A1, as you know, I'm right on top of it, there's nothing I can do, but the saving grace is that I do have a garden which I enjoy at the back, and around, also around the place, so one can relax, and er in that sense I think that it is healthy

> Elaine: Well I mean you've got the A1 which is ghastly, absolutely ghastly, but having said that you sit in the back garden, you'd never believe you had a main road, in the front and I think all the trees, do, must suck up a lot of, some of the pollution. I hope.

Whereas in Brent Cross, residents talked much more about accepting pollution and the problems of the roads, and getting used to it:

> Pam: the problem is I think with the air quality round here, it's erm, it's happened gradually, you know, because the traffic's built up gradually, when we came here there was no, that was only a four lane road, the north circular, with a grass verge in the middle, and then it changed and it's all gradual like the buses, bus routes and erm, more cars and, so it's all built up, it's not something that's happened, suddenly

> Nigel: I'm probably not getting the real natural fresh air because of all the traffic, but apart from that you know it's not too bad. It's just something you have to live with isn't it.

> Julie: when we did move here the north circular road was just erm, just a dual carriageway really, but I mean that's a fact of living in London, I think some things you have to accept and some things maybe you can change, but, it's a main arterial road, junction with the M1, and..... no it doesn't bother me.

This ability for the neighbourhood context to act as a buffer in experiencing environmental hazard and risk acts both within the immediate vicinity, as explained above, but also over a wider geographical space. Thus residents in Totteridge, although not experiencing much air pollution locally, also expressed that their pleasant neighbourhood provided a retreat and place of recuperation from poor air and other environmental stresses experienced in other places.

> Kate: I mean here you just, you just, you know you can rest your eyes on a field or just seeing grasses and no houses, whereas, when you're in Hendon, or when I'm standing in the playground, you've got lorries and cars going by, you've got, playground, you've got a huge school behind you, you've got millions of houses with like, you know, all business going on and all traffic lights and, ugh, no, I mean the difference ... yeah, it's nice to come here, and just, you know you can just get out in the garden, or just look at the garden......

> Mrs Coates: I mean I just am aware of the difference in the air, going up to town and not going up to town.

> Maria: My poor dad when he used to come up and .....as he, I mean he lived in the middle of Farringdon Road, and as he used to get off at the station he used to say 'oh that's better, now I can breathe properly', he always used to say the air was nice here .... you know he used to look around and see a bit of green and you know, 'oh lovely', [..] be better

The ability for the residential environment to provide a protection from the effects of environmental stresses seemed to work on both a physical and psychological level, both of which are important to health and well-being in the wider sense. In the final analysis, perhaps, these two levels cannot in fact be separated, as the better physical environment gives clear psychological benefits. Thus both the material and symbolic significance of air pollution as discussed previously are important in the experience of the risk and its impacts. These come together in the concept of the therapeutic landscape (Gesler 1992; 1993; Williams 1999) and indeed the above examples show clearly how both Totteridge and to some extent Hampstead, because of certain physical and symbolic attributes, were portrayed as everyday therapeutic places (see Wilson 2003).

5.6 CONCLUSIONS

Overall, participants in the research felt air quality to be fundamentally important for general health. Substantial proportions of people felt that their own health was affected by adverse air quality, and even more thought that the health of people close to them was affected. This corroborates the relatively high figures for health concerns found by Elliot *et al.* (1999) and Bickerstaff and Walker (1999). Health impacts also appeared to be more felt and of greater concern than did other impacts – again this agrees with the findings of Bickerstaff and Walker (1999) and Moffatt *et al.* (1995).

It is possible to identify a fairly clear and coherent lay understanding of the health effects of air pollution. The perceived effects are mainly thought to be exacerbation of respiratory conditions, particularly asthma, and of rhinitis type allergies including hayfever. To some extent there is a belief that air pollution may induce the onset of some of these conditions, particularly asthma in children. As well as conditions of the respiratory tract, there is a less strong feeling that air pollution may affect skin conditions, such as eczema. Possibilities were also raised regarding developmental disorders in children, cancer, other irritation type symptoms, for example of the eyes, and other lung conditions.

A well as these specific, clinical conditions, the lay understanding of the health effects of air pollution showed up in a belief that poor air is just generally bad for the health, in a long term, systemic way which may not be identifiable as one condition and may not show up as a specific set of symptoms. In this way, air quality was thought to cause general tiredness and unhealthiness, and perhaps to shorten life expectancy. Here lay understanding is different in its approach from medical understanding, which seeks to isolate causes and effects. Lay understandings, I would argue from this study, tend more to take causes and effects in the context in which they are experienced, where strict separation and reduction is less relevant. In addition these lay understandings seemed sometimes to concentrate on the symptomatic expression rather than the strict clinical pathways of a disorder, so for example not making a clear distinction between hayfever and allergic rhinitis caused by other allergens.

It is fairly striking that the lay beliefs of the health effects of air pollution are not very different from the current scientific evidence. Evidence that air pollution exacerbates asthma and other respiratory conditions, and allergic conditions, is fairly strong in the scientific literature (see chapter one). As with the lay epidemiology, the science regarding effects on eczema and related skin conditions is hazier, but there is speculation. Even the feeling that it may have an effect on the development of the foetus or of young children is emerging in the scientific literature – mirroring rather nicely the common sense knowledge of mothers and pregnant women that they should avoid exposure to exhaust fumes.

The main difference between the lay knowledge and the scientific literature is in the willingness to attribute causality. The public, at least in this study, are fairly willing to believe that air pollution can cause the onset of conditions, particularly asthma, whereas the current scientific evidence would seem to show otherwise. Nevertheless this may not be an important distinction in real life terms, or in political terms. It may also be as Wilkinson (2002) speculates, that the mechanism behind exacerbation and causation is actually the same, and it is the threshold in the degree of symptomatic expression only, which makes the distinction.

Uncertainty proved however to be a characteristic of the lay knowledge described in this study. As Moffatt *et al.* (1995) found, it was frequently unease that was being expressed, rather than a definite belief. This is another reason why the belief in causality should not necessarily be taken in the way that a scientific acceptance would be. Science is by its nature cautious in its assertions, whereas people will express their worries. Bickerstaff and Walker (1995) also found uncertainty in peoples beliefs about the health effects; they saw this as a 'partial link' being made which they surmised could be due to abstraction of one environmental factor from its context – this could be the case in my study also, although it is difficult to corroborate or negate this idea, but people did offer alternative explanations at the same time as talking about causality e.g. of asthma. However the conflict between the scientific epistemology of abstraction in order to study, and the lay epistemology of seeing cause and effects in context is important, as I mentioned above.

The greatest effects of air pollution were felt by those with asthma, chest problems and allergies. Again this is not really different from what scientific studies would predict. As Elliot *et al.* (1999) found, the empirically exposed lay knowledge in fact complements scientific studies. One important difference however is that having heart disease led to few raised perceptions of effect or vulnerability, and heart disease sufferers on the whole were not seen as a particularly vulnerable group; according to medical studies however heart disease can be badly affected by air pollution and is one of the main disorders leading to hospital admissions and deaths brought forward during air pollution episodes. This would appear to be a gap between the science and lay knowledges, which may need to be investigated further and addressed.

As well as people with chest problems and allergies feeling most vulnerable themselves, they were also seen as the most vulnerable groups by people in general. Many people justified their own invulnerability by the fact that they did not suffer from chest problems. Bickerstaff and Walker (2001) saw their similar findings as signifying a 'perception gap', i.e. an unwillingness for people to see themselves as vulnerable, and a kind of denial by putting the consequences onto another group. This is interesting and could be the case, but people may also be being realistic in physical terms – it would be in line with scientific explanations and would also corroborate the chest problems sufferers' own feelings that they feel the effects more.

Other non-health related impacts of pollution were also felt, and were mainly related to dirt, both outside and inside the home, and on the person (see also Moffatt *et al.* 1995). A few other effects listed here were interestingly to do with mood and quality of life; these could also be seen as further health impacts in a broad sense. On the whole the non-health impacts seemed to be less of a concern than the possible health impacts, but they were actually connected, in that the presence of so much dust often alerted people to the presence of pollution and caused them to think about what the health effects might be. As these dirt related impacts were largely to do with the home, it is not surprising that they were felt most in the more polluted area of Hampstead Garden Suburb. These impacts are also probably mostly linked to high levels of particulate air pollution in particular.

On the whole, respondents did not change their behaviour very much in order to cope with pollution. The most common action was keeping windows closed, especially those which faced the busy roads. People also avoided walking along very busy roads where possible. Most people did not feel that staying in was feasible, and very few people thought that complaining to authorities would achieve anything. People with chest problems, allergies and eczema were more likely to avoid busy areas and stay inside if possible at times of high pollution, and inevitably were more likely to use medication. People with children were also more likely to avoid polluted areas. Ironically, poor air quality would be more likely to make some people drive if they had to go somewhere, as they felt they could better control the air, and probably the general quality of the environment, inside their car.

There are some points to be made in this chapter relevant to arguments about environmental equity. As discussed in chapter two, environmental equity studies traditionally map residential concentration of toxins and pollutants, taking this as some degree of proxy for exposure. However the finding in this study was that residential concentration (although difficult to measure anyway) did not affect levels of perceived personal health effects, nor even of perceived health effects of air pollution in general. The reason for this seemed to be that peoples experience of and exposure to air pollution seemed to occur over a wider geographical sphere, including where they shopped, went to work and so on.

The population that emerged as the most vulnerable in terms of the experience of the impacts were those with chest problems and allergies. These could be defined as the people suffering the greater amount of the burden of air pollution risk. Children could also be included here as many people felt secondary concern for them, and they were not included as participants in this study to be able to register it themselves.

Of course the issue is more complicated however. If asthmatics and lung disease sufferers are the most vulnerable group in experience as well as medically defined, these may indeed be concentrated in poorer areas – in this study the highest asthma incidence was in the Grahame Park sample (see appendix 8) - although in this case the poorer areas were not necessarily the most polluted. Another issue is smoking – as there were more smokers in the poorer areas this acts both to compound the effects of bad air, but also to give people less basis both physically and morally for blaming air pollution for any ill health.

The other big issue for risk and equity however is as Elliot *et al.* (1999) pointed out, that the neighbourhood context affects how people suffer the impacts of poor air. In Hampstead for example although the air is known to be bad, the physical environment in terms of having gardens and green spaces ameliorates the felt effects, physically and psychologically, and in terms of behaviour, for instance people can hang out washing and open their windows if they have a garden at the back of the house away from the road.

The further point, which was raised by Dorling and Mitchell (2003) is that of choice. In Hampstead, the pollution may be bad but the residents have balanced this against other good points of the area in making their choice to live there. Putting up with the pollution for instance enables them to buy a house which would be out of their budget in another location. They are also socially and physically mobile, so they feel that they do have an alternative – if it is too bad, they can move. They can also escape by weekends away and holidays if it gets too much. This is not the case in Brent Cross, where residents have fewer choices about where they live and so resign themselves to pollution as a fact of life. Nevertheless they also find good points about the neighbourhood, which make the pollution bearable (see also Elliot *et al.* 1999).

CHAPTER 6

Knowledge and Information

The last two chapters have largely addressed the content of the research participants' knowledge about air pollution, its nature and its effects. This chapter will discuss how these knowledges appeared to be formed, and in doing so will address issues of epistemology, the use of personal experience and other sources of information, and will reflect on the relationship between lay knowledge and expert, institutional knowledge.

6.1 IDENTIFYING AREAS OF GOOD AND BAD AIR

As discussed in chapter 4, traffic was identified as the main cause of air pollution in the borough of Barnet. Poor air quality was identified broadly as being as being on the main traffic routes in each local area, the major roads through the borough, and also in central London. As traffic was recognised as the main cause of air pollution, the amount of traffic was one of the main identifiers that people used in order to establish in a general way where air would be bad. Finchley Road, Tally Ho corner, Whetstone, Staples Corner, and Hendon were all identified in this way. The North Circular road (A406) as a particular example was very widely talked about:

> Suzanne: yeah, on to the North Circular, there's a lot of houses in't there, and it's like, a main road. I think that'd be, a bit erm…

> Gianni: Yeah.. but I certainly wouldn't want to live, out of choice I wouldn't want to live on the north circular road. If you gave me a house I probably wouldn't live there!

> Siobhan: The north circular road is a difficult road, I think that's a really, grubby, that is a yuck road. I would say the air quality on that road is appalling.

The corollary to this, which was very strong, was that people identified areas of good air quality as being places where there were trees and greenery. Trees in particular were often cited as actively cleaning the air, or producing clean air:

> Denise: It smells cleaner, when you go for the walks it's lovely cos you go to the Green, open wide space just behind here, and erm it's just beautiful, you just breathe in all that beautiful air, it comes from the trees

> Elaine: I think all the trees, do, must suck up a lot of, some of the pollution. I hope.

> Siobhan: I find the air quality good up there, that's nice. Kind of leafy, so I think that's, whether it just gives the illusion that the air is better.... Maybe... that's the only thing I could say for it, you know because it's so leafy and green, maybe that's the, the reason.

> Norman: mind you I do think trees do counteract it, to a certain degree don't they? They absorb the er, fumes and things, send out oxygen.....

Thus place-based accounts of air quality often used these two indicators – the amount of traffic and the amount of greenery:

> Kate: Well I don't know that much about it, but I would have thought, [the air is good] because there's so much greenery, and there are no really, big roads, here

> Jason: I mean obviously trees they admit oxygen don't they, take in carbon dioxide and admit oxygen, now here [in London] there's no,
> Suzanne: It's all motorway!
> Jason: yeah it's all motorway so it can't really balance off the... chemicals in the air, you've just got too much pollution going in, and not enough oxygen from the trees.

Part of the reasoning for this seemed to be a kind of lay science, physical realist reasoning. Traffic produces pollution, and trees help filter pollution and produce oxygen. If the balance is not right, there will be excess pollution.

However, as I explained in chapter 4, people had a sense of polluted, poor and unhealthy environments, where traffic was one of a set of characteristics including crowds and litter. Central London was the iconic example of this, epitomising the unhealthy city, an unnatural environment which caused people to be unhealthy both physically and mentally. This could also be interpreted as the classical non-therapeutic landscape.

Similarly, an extension of the role of trees and greenery was that places associated with good air were strongly connected to the countryside and natural environments. These were different for different respondents, reflecting their experiences, but included Scotland, Ireland, Switzerland, Cornwall, Wiltshire, Sweden, and Northumberland. To some extent people were recycling symbolic, Arcadian images of the countryside as being the ideal, healthy environment (see also Bickerstaff and Walker 2001), and these kinds of environments were seen as archetypally healthy, with good air, peace and quiet, no dirt, and a less stressful pace of life.

> Julie: I often visit Cornwall, and .....you're more aware of the fresh air.... instead of the dirt, noise, the pollution, of living in London......
>
> Anne: I mean I come from Swindon, so it's like a town, but, you've country sort of five minutes, it's like going from here two miles down the road and you're there, do you know what I mean, but.... it's a lot slower pace of life, people have more time for you, sort of they speak to you and whatever, whereas here I find it's not, you know they all go about their business, and that's it.
>
> Caroline: especially with a young child you think about that, you know, you want sort of like, you think of somewhere healthy, grow up on a farm, and wide-open spaces,

So again, talk about good air and poor air could to some extent be seen as symbolic of a wider set of values about environment, lifestyle and health. This operates at the same time as a realist sense of the physical and chemical processes that make up the tangible risk. Rather than being in conflict, these two levels seem to reinforce each other, each being used to add strength to the argument of the other. Again, they can also be seen as the combination of elements that make up a 'therapeutic landscape', and this case study provides a case in point of how everyday landscapes may be analysed in this way.

6.2 PERCEIVING AIR QUALITY IN A PARTICULAR TIME AND PLACE

Perceiving the ambient air quality at any given time and place involved certain specific ways of knowing, which were highly embodied. In the semi-structured interviews, I asked people if and how they could tell when air pollution was bad at a particular time or in a particular place. Several aspects emerged, though the framing of the question did mean that they were concentrated on noticing negative aspects rather than positive.

6.2.1 Sensory ways of detecting air pollution

Physical senses played a very important part in people's detection of air pollution. Smelling pollution was talked about most, but also seeing it, tasting it and feeling it:

> Elaine: well you can smell, smells horrible. Well you know it's the fumes isn't it.

> Pam: And erm, and it doesn't, it isn't very healthy, sometimes, you can smell, the exhausts, you know?

> Caroline: because I have a very high sense of smell, and sort of like I can smell things, you know, sort of like diesel and stuff like that,

> Maria: you can taste it. You know you can taste it there [at Tally Ho corner], it's noisy, it's dirty, it's smelly,

Richard: we can see, erm, the pollution on the high road, if you look out on an evening, you can actually see a haze
Denise: the further out you go, the cleaner it is, but the further you go into town, you can just, you can see it and you can feel it, the smog, and, definitely filthier.

People also talked of being able to feel when the air is good. This again was in a quite embodied, physical sense, though unspecific in terms of how it was felt.

Mrs Sharma: Sunny Hill park, which is huge, although it's got the north circular on one side and er, A1 and all this, but still because I suppose it's the green and the trees, that take in all the thing whatever, so, when you go for a walk there you can feel the fresh air, there and also like er when I visit my sister in Golders Green, that Hampstead Heath there, that's another place like ...you can actually, really feel the air.

Nigel: if I walk round the park obviously the air situation does feel a lot different to what it does if you was walking along the north circular road.
R: How does it feel different?
Nigel: well it just feels fresher, you know,

Awareness for many people also came from seeing the effects on the physical environment. Seeing dirt and dust on surfaces, particularly windows, would alert people to the presence of pollution. As I discussed in chapter 5, this was one of the impacts of pollution which the residents close to the main roads talked of feeling in their homes on a constant basis.

Pauline: because of the traffic, the pollution, I mean I can wash those walls down, they're not so bad since I put the glass windows in, but if I've washed them down one time, two days later....

Suzanne: you know where, like the houses are, and they live like, they've got a road right in front of their house and all the, erm, houses have windows and that go black, because of all the fumes come, over the windows... where would you say there's a lot of er..

Jason: a lot of pollution you mean?

Suzanne: yeah

Siobhan: now my windows are absolutely filthy, that's one thing I do notice, er, they're probably pretty grubby here anyway, but, at the front you can actually see that they're quite grubby, so that will be from the traffic, that's definitely from the traffic.

This again does imply that levels of particulate pollutants might be particularly important in how people perceive levels of overall pollution, as other pollutants such as NO and ozone do not create such depositions.

6.2.2 Awareness through physical effects

Another important way in which many people would be alerted to poor quality air would be through the direct physical effects on themselves, normally related to adverse health effects, particularly effects on the respiratory system, such as coughing, wheezing and sneezing. These were symptoms of the disorders that people felt were made worse by poor quality air (see chapter 5) and so these would act as a kind of barometer for air quality:

R: How can you tell, where you say the air quality is worse, what makes you think it's worse?

Claire: Well I know from my nose, when I get home, my nose, I need to use a tissue more frequently, and I need to, literally, erm.. clear out the block from, so... especially if I'm cycling behind a bus..

R: how can you tell when it's bad?

Mrs Coates: Well your breathing.

R: How exactly does it affect your breathing?

> Mrs Coates: Well I think you do, you're very conscious of your, much more shallow breathing, you really can't [...] and of course you're sleepy,

> Sally: it's like if you're sort of walking along and you are walking alongside the traffic, then it is because you've got the fumes coming out of the exhausts, and you can tell cos you start wheezing or whatever, you know, you know yourself, you can sort of subconsciously feel it, or you start spluttering when you get indoors,

So at the same time as connections being made between air pollution and its impacts, the impacts were used to form awareness of pollution levels.

In the survey, respondents were asked, 'do you think you can tell when air quality is bad?' (Q20a). Overall, 18% answered 'yes always', 68.5% answered 'yes, sometimes', 4% 'no, never' and 6.5% 'don't know'. (3% were missing). This variable was recoded so that 'no' and 'don't know' were the same category, due to the small numbers.

People with hayfever or rhinitis were more likely than expected to answer 'yes always', and less likely to answer 'sometimes', or 'no/don't know' ($X^2 = 19.223$, d.f. = 2, p = 0.000). Those without hayfever were more likely to answer 'sometimes', 'no', or 'don't know'. People who had said they believed they had an illness caused by air pollution (Q11a) were more likely to answer 'yes always', and less to answer 'sometimes' or 'no' / 'don't know' ($X^2 = 9.650$, d.f. = 2, p = 0.008). People who felt they had a health condition made worse by air pollution (Q12a) were also more likely to answer 'yes always' and less likely to answer 'sometimes' ($X^2 = 15.617$, d.f. = 2, p = 0.000). This would corroborate the theme from the interviews that people often become aware of poor air by the physical effects on themselves.

Living in different areas was associated with responses to this question also. Residents of Hampstead Garden Suburb and of Brent Cross, the two areas of higher modelled pollution, were more likely than expected to answer 'yes always', while residents of

Totteridge and Grahame Park were less likely to do so ($X^2 = 17.395$, d.f. = 6, p = 0.008). Grahame Park residents were more likely than expected to answer never or don't know.

A binary logistic multiple regression performed to check these relationships however did not find any single significant associations with either the health conditions or area of residence and the overall model was not significant. This model would however have been hard to fit due to the small numbers in the categories, and so does not necessarily invalidate the bivariate analyses.

No other associations of interest were found with socio-demographic variables, including education.

People were then asked, if they had answered yes always or yes sometimes to Q20a, to say briefly how they could tell. This was an open-ended question which was coded post hoc and more than one coded category could be assigned to each answer.

154 people gave answers here, with a total of 247 coded responses. These were as follows:

Table 6.1: How people can tell when air quality is bad

Way of telling	No. people
smell	68
visual, either haze or dirt deposits	61
effect on asthma or breathing	50
other specific physical symptoms	25
unspecific feeling, 'heavy air' etc	22
taste	11
traffic congestion	6
tiredness/ general bad physical feeling	4

Sensory means of knowing clearly emerged as very important – smell, sight and taste, with smell being the most dominant of these. Again, it was clear as in the interviews that another way of knowing was by direct physical health effects, particularly on the chest and breathing. Observation of traffic was again noted, even though the question referred to an immediate kind of knowing rather than knowing where one would expect air to be bad.

So far the ways of knowing about air quality which I have described have been very much based in the experiential, sensory kind of knowledge highlighted by other researchers, notably Bickerstaff and Walker (2001) and Elliot *et al.* (1999). These authors felt that direct use of the senses was the most important means by which people became aware of air quality. However these are ways of knowing in particular circumstances; other questions about knowledge and information in this study elicited information about other kinds of ways in which people gained knowledge of air pollution, notably through uses of expert-produced information in the public domain.

6.3 KNOWLEDGE BY COMPARISON

One very important and very apparent aspect of how people formed knowledge about air quality was through comparison. The questionnaire format could not capture this, but it was very clear in the in-depth interviews. This comparison could involve sensory feeling, health effects or aspects of the physical environment as elaborated above, but it came across very strongly that awareness of the effects, as they were often felt to be quite subtle, was often brought on by the contrast with experience of other places.

Sensory comparison:

> Elaine: Oh yeah, always, yes, yeah I think it's probably terrible, when you go out to the country and you step out of the car, it hits you, the difference, because it's sort of sweet air.

> Michelle: You know, you know yourself if you're at the seaside or somewhere the air feels fresher and cleaner for some reason.

Health/ feeling comparison:

> Mrs Coates: I mean, our [grandchildren], they sleep and eat and feel better when my children are in France, which is, France is a big country so you've no, no concentration of houses and so on, they live on the seaside, and it's wonderful, wonderful air, and you definitely feel better,

> Mrs Chan: I can't complain a lot, but when I come back from Scotland, er.... I feel straight away different, I do feel different, because there, is beautiful, you can feel different, when I come, very quickly, I feel different, but if you stay here for a long while, you don't feel so much
> Karen: you know I'm from Ireland originally, and out there you just feel so much better, because you're by the sea, and, so erm, but you just get so used to it that you don't necessarily attribute it to living in a city you just think it's how you feel, it's only when you go away you think, god I feel terrible when I'm at home. So, I'm sure that is pollution.

> Pauline: I went to Centre Parks for a week, and the difference in breathing between there and here, it hits you. And when I go north, it hits you.

> Norman: you see this sort of thing creeps up on you, you don't know it's, all these fumes and things, you don't really realise it until you get out, into the open and the fresh air and take a walk through the forest... you feel different.

> Jason: I used to live up in Liverpool, and erm, it wasn't very near the town centre, but I'm asthmatic, and, when I was living up in Liverpool you could actually tell the difference between London and Liverpool. I mean in the, trying to go to sleep at night, stuff like that.
> Suzanne: what was worse then?
> Jason: London, by far, like. It was quite worse.

Some of these health-related comparisons involved quite specific symptoms, such as wheezing, but many did not, being more about a broad, general feeling of health, where sometimes again the images of the unhealthy city and the healthy countryside were invoked.

Physical environment comparison:

> Denise: where I was I was not actually backing onto Finchley Road, but I was, our house was like a central reservation so you still got fumes from Finchley Road coming in, all this black dust and everything which you never get here. Yeah so it's definitely, we feel healthier to live in this area.

> Pauline: Yeah. I notice how clean, how clean everything is [near Durham], how you don't wash your clothes as much. I don't mean that you don't, I mean here you can change twice a day, can't you, there you know things look cleaner for longer. The gardens look nice, everything looks nice

This comparative aspect of lay knowledge formation is a particularly geographic way of forming knowledge. It involves place-bound experience accumulated over a lifetime, and awareness of the personal embodied experience of being within different places. This process is similar to the kind of context bound, local knowledge formation that Bickerstaff and Walker (1999a, 2001) wrote of, but extended over a wider geographical scale and reflecting people's mobility.

6.4 USE OF MEDIA AND PUBLIC INFORMATION SOURCES

The media and its treatment of air pollution were not intended from the outset to be explored as a particular theme in this research. Nevertheless it became apparent that significant knowledge and information about air pollution was accumulated by the research participants from broadcast media in various ways. Certainly, knowledge about the global aspect of air pollution issues came from these kinds of sources, largely though not exclusively through TV programmes:

> Kate: you sort of wonder though when you watch these programmes on the telly, you know the news of this summit they've just had about erm, this pollution thing

> Claire: I was listening to a report on the television about erm, on channel 5, and how, erm, air traffic is contributing to air pollution and the ozone layer

> Sally: See it on the telly, you know little snippets here and there of different things, you know, certain things affected it, I mean I remember a few years back they had things on aerosols you know, we should cut down on the aerosols, you know that was contributing to the erm, ozone layer and all this sort of thing

Newspapers were also a source of information for this:

> Gianni: yeah, papers are always covering global warming and air pollution, and then erm, I think on the news they're always giving air quality aren't they, some kind of rating.

> Caroline: I don't get a lot of time for reading these days, but [laughs] you know sort of like er, you know report things from magazines or papers or, local papers where it says oh, you know, the, degrees of sort of pollution have gone up by x number of per cent

Local papers came across in the qualitative interviews as an important source of local information, and where people would expect to find articles or news about local air quality and any new initiatives. This came across particularly in the context of people *not* having heard about local air quality management:

> Phil: I seen nothing come out of Barnet at all, nothing in the local papers,

> Mrs Coates: phh, well we've had nothing, have we, house to house, erm, we've had, I've not been aware in the free papers, the Barnet Press, Hendon and so on

R: I guess what I'm getting at is how do you become aware of these things, where do you get these, arguments from?

Len: local ones would be from through the local newspapers, like the Press, or the Hendon times, or the Hampstead and Highgate Express, they're fairly sort of vociferous about, if someone comes up with some unknown sort of contamination,

R: er, I asked you about scientists and doctors and air quality and you said that you read about it occasionally?

Nigel: Oh yeah occasionally they mention it in the local paper, you know you get like bits about, people writing in about certain things and when someone's [..] who lives somewhere around here, they sort of made an opinion about the traffic as well.

In the survey, people were asked, 'where, if anywhere, have you heard or read anything about air pollution?' Again this was an open-ended question , coded post hoc with more than one answer possible per respondent. Overall 137 people answered, with a total of 243 responses, as follows:

Table 6.2: Where people heard or read about air pollution

Source of hearing or reading about air pollution	No. people
newspaper/magazine	95
TV	93
radio	22
school/educational setting	11
borough council	4
environmental organisations	4
other people	3
library	2
internet	2
at work	2
medical profession	2
aware from travelling to other places	1
London Transport information	1
teletext	1

These were slightly different in the different areas: a greater number of people cited newspapers or magazines in Totteridge than TV (33 vs. 24), and they were almost equal in Grahame Park (22 newspaper, 20 TV) whilst more in Hampstead and Brent Cross cited TV than newspaper.

When phrased in this way, with air pollution as a general issue rather than as an immediate presence, clearly media is an important source of information, and this related particularly to the global dimension of the risk. This is rather different from the arguments of Bush *et al.* (2001b) and Bickerstaff and Walker (2001), who feel that personal experience, and by extrapolation the local dimension, are the most salient in public understanding of air quality. My findings however suggest that this might be a rather circular argument. People's own experience may be more important in the everyday sense of gauging air quality in any given locale, but if the global and abstracted dimension is considered, and clearly it is among the public that took part in this study, then the media and other institutional sources of information become very important. People do indeed process their sensory experience and notice any physical effects on themselves, and this will alert them to the presence of pollution; nevertheless the accumulation of knowledge over time from a variety of institutional sources is an important process. These two dimensions need to be seen as linked; information about air pollution, its nature and its effects gained through the institutional level helps make sense of and validate the personal, everyday experience. Likewise the personal experience makes relevant and personalises the abstract risk.

There was some expression of distrust in the media as a source of information, mostly associated with national newspapers. Local papers did not seem to be seen in the same way.

> Elaine: you get spouted facts and figures which I think can be manipulated actually, figures, er that they churn out, you also can read about every day but I don't know how meaningful it is, how it's manipulated......
>
> R: So this is in the media?

Elaine: yes, you know you get a, well I suppose they like to give you shock headlines, but when you look into it more deeply, it doesn't always stand up

Julie: I would not take on face value anybody's opinion.

R: How about the newspapers, would you -

Julie: Oh no! [laughs] no no no! You've chosen to do your research after the attack on America and we're getting so many conflicting views, even in the same news report.....

Another specific kind of information in the public domain is the information on ambient air quality which is available daily through different media. To look at the use of these kinds of public information sources, respondents to the survey were asked how often they use various sources of information to know how good or bad the air is (Q21). For each source listed, respondents were asked to circle a number from 1 to 5 to indicate frequency of use, where 1 corresponded to 'never' and 5 to 'always'.

The overall means were as follows:

Table 6.3: Frequency of use of information sources to ascertain air quality

Information source	mean	Std. Error
TV forecast	3.04	.10
Own experience	2.53	.08
Radio forecast	2.50	.10
Newspaper forecast	2.11	.09
Teletext	1.58	.08

'Own experience' was included as a way to evaluate this directly against other possible ways of knowing about ambient air quality in a time- and place-specific sense.

TV forecasts were significantly more used than all the other sources of information. 'Own experience' was significantly more used than newspapers or teletext, but about the same as radio, and significantly less than TV. Teletext was used significantly less than all other sources. None of them however were very frequently used: TV as the most frequent corresponded to a rating of 'sometimes'. 'Own experience' was on average used between 'occasionally' and 'sometimes'. The relatively small standard error here also shows that there was not a large amount of variation in responses.

This would seem to indicate, as the interviews also suggested, that air quality is not something that most people positively evaluate very often. Sources of information might be used occasionally but the interviews also suggested that this was often passively, as the information was given during weather forecasts, rather than actively sought out. This is probably also significant with respect to people's own experience. As the above discussion and previous research has shown, people's own experiential knowledge is an important way for them to perceive air quality. However this does not mean that they do this all the time. Their senses and a comparative awareness for example may alert them to air quality at times, but it appears this may be a kind of passive process which happens sometimes, rather than something which people actively consciously do.

Interestingly, there was no difference between different areas in the frequency with which people said they used their own experience. This lack of difference held also in a multiple regression controlling for health conditions. Again this would tend to indicate that people's experience of air pollution is not residence based, or at least that their ability and tendency to distinguish air quality themselves is not developed further by living in poorer air quality.

There were also few other differences by area. Brent Cross and Grahame Park had a slight tendency to use the TV weather more. There was a negative correlation between using TV forecasts and income (coefficient -0.267, $p = 0.001$). Older people were slightly more likely to use the radio forecast (correlation coefficient between age and use of radio = 0.152, $p = 0.035$).

Asthma sufferers used their own experience significantly more: 3.06 c.f. 2.42, $t = 2.925$, d.f. = 186, $p = 0.004$. This fits in with what came out of both the interviews and the survey, about physical effects, particularly on breathing, being one of the important ways in which people know when air quality is poor. Asthma sufferers did not however use any other sources of information more which is again perhaps surprising. People with other chest problems used newspapers slightly more (3.41 c.f. 2.42, $t = -2.145$, d.f. = 192, $p = 0.033$). Hayfever/rhinitis sufferers however used all sources more apart from teletext. Comparative values were 2.39 c.f. 2.0 for newspapers ($t = 2.078$, d.f. = 192, $p = 0.039$); 3.41 c.f. 2.9 for TV ($t = 2.416$, d.f. = 195, $p = 0.017$); 2.95 c.f. 2.33 for radio ($t = 2.688$, d.f. = 83.881, $p = 0.009$) and 2.81 c.f. 2.42 for own experience ($t = 2.164$, d.f. = 186, $p = 0.032$).

People who felt they had an illness caused by air pollution used newspaper forecasts more frequently (2.51 c.f. 1.95, $t = 2.734$, d.f. = 85.823, $p = 0.008$), TV forecasts more (3.52 c.f. 2.85, $t = 3.154$, d.f. = 190, $p = 0.002$) and also used their own experience more (2.90 c.f. 2.38, $t = 2.805$, d.f. = 181, $p = 0.006$). They did not use radio or teletext more for air pollution information.

People who indicated that they had a health condition made worse by air pollution however used TV forecasts more frequently (3.31 c.f. 2.89, $t = 2.100$, d.f. = 193, $p = 0.037$), used radio forecasts more frequently (2.76 c.f. 2.35, $t = 2.078$, d.f. = 187, $p = 0.039$) and used their own experience more (3.01 c.f. 2.25, $t = 4.553$, d.f. = 184, $p = 0.000$). For this group, although TV was still ranked the most frequent, it was not significantly more used than their own experience. So for this group, own experience seemed a relatively more important way of knowing about air pollution, although not more important than the media.

6.5 KNOWLEDGE ABOUT THE HEALTH EFFECTS OF AIR POLLUTION

Another aspect of lay knowledge formation that I was interested in was that of how people form their ideas and beliefs about the links between air pollution and health, or to put it another way, how a lay epidemiology might come about. This was a somewhat different question from how people formed an awareness of air quality itself, and involved some different processes.

6.5.1 Observation of self and close others

From the interviews it was apparent that one important way in which people formed beliefs about the health effects of poor air quality was through making associations over time between air quality and exhibition of certain symptoms either in themselves or people close to them, especially their family. Unlike epidemiological methodology, which uses large numbers of cases to make associations between possible causes and effects, often at a temporal cross-section, knowledge in this way could be from a small number of cases but observed in detail and over time:

> Denise: Right, talking about pollution I mean my daughter and my husband's asthma is hardly, is not as bad as it was where we lived in, in fact they developed asthma, both of them, when we lived in town... here they don't have to use it so much,
>
> R: what you mean the inhalers?
>
> Denise: Sorry yeah the ventolin, yeah, so you know, must be something to do with the air.

> Denise: erm yeah my sister, she suffers really badly, especially, since she's come to this country because she was living in Spain, she gets this sort of it's like a hayfever but it's not hayfever, they really can't pin it down so she's had you know those skin tests sort of thing, they say it's a bit of pollen and a bit of dust but, sometimes it's absolutely awful.
>
> R: So it's just, it's like, allergic rhinitis?
>
> Denise: yes, that's right, yeah it is, yeah, and I think it's the pollution since she's been here. Yep.

> Mrs Coates: 'Cause I used to do some postgrad research at the Institute and I used to walk through from Euston, but I could hardly walk, ... I worked in Somerstown doing the work, and I used to feel quite poorly most of the time, and I thought it was pollution.

Sally: and I find the kids, they have eczema and things like that, you know I think that's from pollution and that, do you know what I mean, the way the skin is.

Sally: yeah, if I sort of go on to the tube and that, I find then I'm coughing and sneezing a lot when I come home, yeah, you know, I'm not chronic asthmatic but, bad enough, yeah, and I've only been asthmatic for the last couple of years so it's, you know, something to me that would concern me, that,
R: where do you think that came from then?
Sally: I'd say from here, from the pollution, I mean, I never had it before,

This kind of accumulation of knowledge through experience and anecdote is the kind of process that Williams and Popay (1994) highlighted in their work on lay knowledge and public health (see section 2.3.3), in particular in that it is biographical and narratively based. Similarly, it has the characteristic of 'learning through doing' that Layton *et al.* (1993, cited in Irwin 1995) saw as typical of contextual lay knowledge. In this, it could represent an epistemological challenge to science as Williams and Popay argue.

6.5.2 Common sense

As well as accumulating observations as described above, often people just expressed that air pollution must be bad for you, as a kind of common sense:

Elaine: it can't be doing you any good. Is what I feel, breathing in, you're breathing in poison all the time,

Mrs Chan: I imagine, if I have a house in Totteridge Lane I would never open my window in the front, I can imagine the, breathing in, sticky lung, I can't think it do any good. I don't think so.

Pauline: well if I've got anything wrong with my lungs it will aggravate it. It must do. Must do.

Jason: you're breathing in all them exhaust fumes, so I suppose daily that can't be that good for you, no, it's got to do something to you in the end hasn't it?

Two particular instances of interesting and widespread reasoning which could be regarded as examples of common sense, recurred in the interviews. One, as discussed in section 5.5, was about how children in pushchairs must be vulnerable to pollution from vehicle exhausts:

Kate: I remember my older sister who lives in erm, more built up area, worrying, when her children were small, about the fact that her child in a buggy was exactly at the height of exhaust fumes, coming out...

Mrs Coates: do you know what worries me, is the pushchair syndrome, er, exhaust height, er, you watch them in town, push the pushchairs along, you know Tottenham Court Road, and the exhaust pipes are billowing out,

Erica: Well, I think I thought about when I was pushing erm, any of my grandchildren they are all a bit older now but erm, you know in their little buggies, because at that low level I think you know they're getting, it's a complete sort of, erm, emission gases and so on,

The second was the reasoning that air pollution must affect people in a similar way to smoking:

Phil: That's right, you know, as a mother, presumably a mother who smokes, we know that a mother who smokes is more likely to have underweight children or children with this problem, that problem, statistically we know that, but is there really that much difference between a cigarette, or, from breathing polluted air due to, due to traffic fumes? Presumably not.

Denise: to me, if you're breathing in a fume, it can't be very good for the body can it, it's like having a cigarette it's not really good for the body, it's the same sort of thing, so why shouldn't breathing in air pollution, fumes from cars, be any different?

Mr Robson: I don't smoke, I used to, but then I say to myself, what's the difference, I'm walking up the street there and I'm inhaling all that, lovely, the fumes and that, so, you know, that's always in the back of your mind, you go out here today you're going to walk up there and what's going to happen? You're breathing it in.

These can be regarded as common sense in that although there was some original basis in science, such as basic physics or chemistry, the reasoning process seemed to make obvious sense to the interviewees, without any recourse to validation by expert or institutional knowledge sources.

6.5.3 Uncertainty and alternative explanations

Nevertheless, people often expressed uncertainty at the same time as asserting their common sense knowledge. Although they felt there were strong common sense reasons for making the links between air quality and health, and feeling unease, there were different degrees of conviction and often alternative explanations were given as well as expressions of uncertainty (see also section 5.1).

Len: Well I think they just feel the children get more throat complaints these days and things of that nature, and perhaps it's caused by fumes, air pollution and dust-borne particles and the like. But, all those things as I say are long term so it's very difficult, to really put it down to that if in 20 years when erm they're grown up they have something it's hard to say well that's because you lived in...

R: do you think it affects you in any way?
Karen: I'm sure it does, but I don't know. But I'm sure it does, yeah.

Nigel: Well, I don't know, I think it would just er, just affect, it might affect someone, you know, it's difficult to say, probably not, I might just be silly saying this, you know..

R: Why do you think it might be that you feel more tired here than if you go somewhere else?
Pauline: It could be lots of reasons but it could be the air, could be. Can't put everything down to that.

This kind of uncertainty was apparent in the in-depth interviews where there was more room for it to emerge, and people were able to give parallel accounts and even seemingly contradict themselves. This could not emerge through the survey technique where, 'don't know' options notwithstanding, the format constrained answers more and made people make more definite choices in their responses.

6.6 EXPERTISE

The main context in which experts and expertise were talked of in the interviews, and indeed framed in the survey, was that of health. Experts in this sense then were often medical, epidemiological (by implication rather than being specified) or general 'scientists' who might be researching the effects of air pollution on health. However other kinds of experts were also important at times, including for example scientists who might be working on alternative fuels, engineers, and transport experts.

From the in-depth interviews it was striking that in general there was a high degree of faith in expert knowledge, particularly scientific knowledge, and in the practice of research as a whole, for example:

R: Do you think the health effects are known by, say doctors, scientists,
Mrs Coates: Well they're obviously doing an awful lot of research.

Gianni: I think doctors and scientists are, they're working on it.

> Erica: I'm sure that erm, there must be knowledge amongst, you know, people in this field, that er, leads them to know that bronchial, or asthma, er, people are very vulnerable, you know must be made worse rather than better to be in a heavily polluted area,
>
> Sally: yeah, yeah, I'd say scientists and doctors know, because they're dealing with people, you know, I suppose the doctors are dealing with the effects of people, you know asthmatics, people with emphysema, things like that, you know, why have they got them diseases, what sort of life do they lead, you know, and then you've got your scientists that do all their experiments of, planets and whatever, changing atmospheres and things like that, weather and stuff. Yeah I'd say they've got a rough idea I would imagine, they would know what effect it's having, yeah.

Some people felt that more research is needed, but the faith in science and research was still apparent.

> Denise: maybe, that's one of the reasons why people, you know, start getting cancer and things like that, because they've never really proved, have they, or done, I don't know if they've done any tests on that,
>
> R: Do you think that scientists and so on, do you think they know
> enough about the effects of air pollution?
> Pauline: No, no I don't. Er.......but then I think scientists have got so much to
> do, so many things to,.........
>
> Janet: I think research is being done into it because I think more and more people are being affected by it, but I think that there's probably still lots more research to be done, maybe on the long term effects and also what could be done perhaps to improve...

So some people thought that at the moment there is not enough known about the effects of air pollution, but this did not translate into a lack of faith in science to find the answers; usually the problem was located elsewhere, such as a lack of funding from government. On the contrary, a high degree of faith in scientific method was evident on the whole, with many interviewees talking in these terms in explaining how knowledge about the effects of air pollution should be gained. Thus rather than being alienated by this kind of epistemology, people seemed to be accepting and reproducing the idea that scientific method, involving controlled comparisons and statistics, is the best way to go about understanding this type of issue:

> Phil: And we don't know, you know, and there's no long-term studies ever been done on a population to find out what the situation is. I mean you know you've got a population of kids brought up in central London and another population of kids who were brought up in, rural Wales, you know they're the sort of, you know, would you have the same number of asthmatics, the same number of children with eczema, the same number of, you know,
> ....*later*.... it's just that it is a long term thing, there's no use doing, looking at the population as it is now, you've got to start looking at the population who lives in a, in an atmosphere that's polluted against the population who live in a more, in a cleaner atmosphere, and then look at the two.

> R: Do you think it affects people in general, air pollution? Do you think it affects people's health?
> Jason: I mean you could probably tell by statistics, over the years like, the increase in asthmatics, and, back in say 1800s and the 1900s you'll see a difference. And cancer rates and stuff like that.

> Mrs Kapoor: yeah, if they give some, something to, you know ordinary people, I mean some sort of, what is called, I mean people test something, the people who is wait half an hour in the very very congested, car passing, and then they can measure, they can tell the difference
> R: So comparing a person who stands by a road with someone who...
> Mrs Kapoor: yeah, maybe this will give an accurate figure which can help people to understand.

In the same way, many of the interviewees expressed an actual deference to expert knowledge. This was often with respect to medical knowledge, but extended into other fields of expertise, including traffic planning, policy-making and air pollution measurement.

> Maria: They're the experts, they know about it, you know there's no point in asking people who don't know, (re: policy solutions, legislation)

> Elaine: so that's what, sort of thing I would model it on, but I am a layperson, I don't know what I'm talking about...(re: traffic planning, comparing London with Vienna).

> Paul: not being a scientist or certainly not an expert in air pollution, I'm not sure what you can do I mean to me the air, you know if you look at sort of air currents and you know, it's sort of blown pretty much everywhere,

This kind of expression of personal relative ignorance would seem to be, in Michael (1996)'s typology, closest to ignorance as 'not my job', expressing a co-existence with science. It did not seem to represent a moral or political challenge to science.

Nevertheless accounts sometimes expressed both assertion of common sense views and respect for expertise or scientific method simultaneously:

> Tony: whether it's worse being in the city or whether it's better and healthier being outside, because there is more and more research on the problems of particularly asthma and this sort of thing, as to whether it really does affect children living in more polluted areas. It stands to reason it does.

> Omar: this kind of potential pollution which is sort of the noise, dust all kinds of, er, particles that are pervading our, air and getting onto our clothes, getting on, inside, wherever, they must add and accumulate, and onto edibles or whatever, they must be doing us harm, I think, well they are I know they are, but I'm not a scientist to be able to say that er, this is the chemical, and this is the physiological

damage it does, you know, so I don't know, er, much about that, just as a, generality, I can say that, no no, people do know,

Mrs Kapoor: I'm sure these thing are not good for the, your system, er, so some medical people can tell exactly which, but generally definitely not healthy for the... health.

This is very interesting and potentially important. At the moment, air pollution from traffic in the UK is an environmental risk which has not been the site of particular conflict. People on the whole may be nervous about the effects but they are still happy with the accepted view that science will be able to inform them about this. However if at some point the scientific view should come to be at odds with the common sense view, then a conflict could occur, as the deference to science and the common sense seem to be held simultaneously, which means they are potentially in tension. If this should be the case, then the difference between the epistemological positions could become more salient, creating a situation closer to that of Wynne's (1992b, 1996) analysis.

At present though, the deference to science seems comfortable and pervasive. In terms of being informed, therefore, this faith in expertise extended into people expressing feelings that scientists should communicate more with the public, and that the public should be more informed by this kind of knowledge.

Janet: I think that they both, I think the public, until the scientists know more and say, well say to the public well this is what it is, I think the public are not aware....

Karen: I'm sure, erm, yeah doctors and scientists and all that know, but whether they think it's erm, I don't think it's er, information is given in layman terms really, you know, I think if you wanted to find out you could but it's not erm, you know it's not generalised.

Sally: I'd say really it should be looked into more, or explained more to your sort of average person, of the effect of what it's doing, you know rather than don't

> drive your car and stop the pollution and have lead-free petrol, I mean I wouldn't know the difference, you know like, I suppose in.... sort of don't know what you'd call it.. chemical terms or whatever, or you know the effect of what's definitely going to happen or whatever, I mean I know it's not good and I know it's all contributing to sort of, something that's going to happen that's not going to be none too clever [laughs] I mean if someone asked me I mean I'm not a physist [sic] or anything like that, I wouldn't know, what, like in particular,

There is perhaps an issue of different knowledge domains as well here. Common sense knowledge was strongest with regards to health effects and the kinds of things that people could see happening with their family and close friends. There was still deference to medical knowledge, but the deference was perhaps stronger and the common sense less applicable with respect to for example air pollution and climate change, or air pollution monitoring.

These questions about people's views on the state and extent of their own knowledge, experts' knowledge and the general public's knowledge were pursued further with three questions in the survey.

First, respondents were asked, 'do you feel that you know as much as you want to about air pollution and what its effects might be?' (Q22). Overall, 20% answered 'yes', 72% answered 'no', 7.5% answered 'don't know' (0.5% did not answer.) No socio-demographic variables had significant associations with responses to this question. Educational levels, media consumption, having particular health conditions, area of residence, income, age – none of these were related to whether or not people thought they knew as much as they wanted to.

The next question in the survey was 'do you think that scientists and experts know enough about air pollution and what its effects might be? (Q23). Overall, 33% answered 'yes' to this question, 53% answered 'no', and 12.5% answered 'don't know'. 1.5% did not answer.

There was a significant association between responses to this, coded as 'yes' against 'no'/ 'don't know', and occupational category ($p = 0.011$). Retired people were slightly more likely than expected to say 'yes'; so were the category made up of students, unemployed and homemakers – a further breakdown of this one showed all the subcategories here were more likely to say 'yes'. Professional and management workers however, were more likely than expected to answer 'no' or 'don't know', and less likely to say 'yes'. Broadsheet newspaper readers were less likely than expected to answer 'yes' to this question and more likely to answer 'no', whereas tabloid readers were the opposite ($X^2 = 7.433$, d.f. = 1, $p = 0.015$). A t test shows that the average income of those saying 'yes' was 0.87 scale points, i.e. £8,700 lower than those saying 'no' or 'don't know' ($t = 2.576$, d.f. = 115.498, $p = 0.011$). These three variables of income, newspaper readership and occupation are clearly connected in the population, and a group of people who have less faith in expert knowledge in this context are characterised by higher income, broadsheet newspaper readership and professional/management occupation.

Having either higher education or no educational qualifications however was not associated with responses to this question. Having particular health conditions was not, nor was having conditions thought to be caused or made worse by air pollution.

Respondents were then asked 'do you think that people in general know enough about air pollution and what its effects might be?' (Q24). Overall only 6% answered 'yes' - a lot lower than the 25% who thought that they themselves knew enough. 86.5% answered 'no' and 6.5% 'don't know'. 1% did not answer.

Income was significantly related to responses: the mean income of those saying 'yes' was 1.39 points, i.e. £13,900 lower than those saying 'no' or 'don't know' ($t = 3.374$, d.f. = 15.398, $p = 0.004$). Broadsheet readers were significantly more likely to say 'no'/ 'don't know' than expected and less likely to say 'yes', with tabloid readers having the opposite relationship ($X^2 = 4.741$, $p = 0.029$ for the cross tabulation), though this result may be unreliable due to the small cell counts. However it is in line with what seems to be an overall trend and so is interesting. It was not possible to test for relationships with occupational categories due to the small cell counts.

The results from the survey show a surprisingly homogenous view regarding the state of their own, public and expert knowledge. The only factors that seem to make a difference are that a group of people characterised by professional jobs, higher income and broadsheet newspaper reading are more likely to think that experts and scientists do not know enough and that the public in general do not know enough. This could be due to a raised concern in this group, which does not seem to be connected with living in a more polluted area.

The feeling that people in general do not know enough was reflected in the interviews. This was variously seen as because people are too busy, which was more the interpretation in the poorer areas, because they don't understand, or because people in general are not very interested:

> Mr Robson: I don't think they [the public] take a lot on board, which they should do, but they don't, they just say to themselves well that's it, I've got to get the food in, I've got to pay my bills off,

> Michelle: I don't really know, I don't think people really, sort of take it serious enough, you know, or sort of understand it.

> R: do you think enough's known about it generally?
> Richard: No, I don't think so.
> Jean: I don't think people on the whole are even very interested.

> Denise: whether everybody takes notice of it, I don't know I think perhaps you, whether you need to be a more sensitive person and it would worry you, erm, I don't know whether it's a class thing or, or what it is, it's something I've always been concerned with it, but erm... other people perhaps wouldn't bat an eyelid.

On the whole in both the survey and interviews, people did not rate the extent of public knowledge very highly. However from the interviews the view regarding public motivation was quite divided between pessimism and optimism. Some, as above, felt that other people were not really interested, but others felt that people just did not know enough or were not told enough, but actually may be quite motivated to do something if they knew more.

Given that so many people expressed a desire for more information to be given in general, in both the survey and the interviews they were asked for ideas on what kind of formats would be appropriate and useful. In the survey, the question was: 'if you think people should have more information about air pollution and its effects, do you have any ideas as to how you would like this to be given?' (Q26). This again was an open-ended answer which was coded post hoc, and more than one category was allowed per response. In total 81 people responded, with a total of 141 responses, which were as follows:

Table 6.4: Proposed sites and sources of information about air pollution and its effects

Proposed information source	No. people
TV	50
newspapers	25
leaflets to door	21
radio	17
school	12
leaflets at doctors surgery	3
library	3
displays/monitors in streets	3
websites	2
teletext	2
at petrol stations	2
workshops / seminars	1

Being given information via the media was the most popular type of response, followed by leaflets delivered to the house. This was very much the case from the interviews as well, where many people suggested having short public information films or even longer programmes on TV, probably sponsored by the government, and also having information through the door, again from central or local government. Other suggestions from the interviews similarly included leaflets at doctors' surgeries, websites and more education about relevant issues in schools.

> Siobhan: just to make people aware of it, campaign on television, that, you know there could be air pollution are you aware of it type thing, maybe it's, that would be, that to me would be a national, erm,.....campaign,
>
> Dan: if you don't mind now I want to ask you a question, how many times have you seen an advert on telly, in a week, about the environment, about pollution and other things, an advert, you know from the government, say, advising people about pollution?
> R: never
> Dan: see, so these are some of the areas, the government can go into, you know, on BBC1 and BBC2, they don't pay any fees for this kind of statements,
>
> Denise: I don't think there's enough literature on it, at all, the councils, you know they don't, there's no literature on how you could perhaps save your environment from air pollution, this that and the other.

6.7 INFORMATION AND TRUST

As I elaborated above, in the main people held a strong belief in the value of science as a project, and, on the whole, in scientific experts as well. There were some exceptions to this however:

> R: Do you think that scientists and doctors and so on, do you think that they know enough about the effects of air pollution?
> Pam: well, no because I think that they're, too much theory, it's like this BSE scare isn't it, I mean look at that, they spent 4 years on a calf's head, or on cattle [...], and then they say, and what was the worrying thing about that, it makes you wonder about this BSE and CJD, because in all that 4 years with all that, all those brains that they tested, they didn't come to any conclusions, and they .... so I think, why didn't they find it in that 4 years? you know? They seem to be, and it

wouldn't surprise me if we had a mad scientist there who cross bred, who put it into a sheep, just to make his point. I don't trust them, I do not trust them

R: Don't trust scientists?

Pam: No I don't, I've read too many things, I know that they at heart, but we have got rogue scientists and they try to keep the lid on it, and they have, do you know they even set off an atomic bomb in space? They talk about us and pollution....

Later... Pam: I don't think scientists go into it with an open mind, I think they sort of think, oh erm, I think that this pollution is caused by A and affects B, so they go in and they look for all the, you know, to try and make it fit A and see how it affects B, but they won't sort of think, oh, mm, it seems to be doing more to C and D, you know they seem to want to make,

R: So they've got an agenda to start with?

Pam: yes, that's right, yes, I don't think they're open minded, I don't think our scientists are, government.

But then: Pam: I do think we have the odd rogue scientist but then I do think we have good and honest people in it, but of course you see the good and honest people don't always get to pull the strings.

Julie: do scientists know.....[pause]......I can't say yes or no to that one, because they're all going to have differing opinions, how am I going to know which is right, some might be biased into their research, I really don't know. But obviously I would listen to any well-informed view.

R: would you trust them?

Julie: would I trust them? No I don't trust anybody! I definitely wouldn't trust them.

R: why is that?

Julie: we're never told the truth, any of the time........sometimes I think that the scientists [are] not giving the public full information because they think it's more than we need to know... I have a very jaded view on it all.

On the whole though, when distrust was expressed, which it was fairly often, it was located in other places, with the feeling that scientists do not have control over what happens with their work. The distrust was in the agendas of policy-makers, while scientists were not generally linked with politics.

> Paul: there is a lot of information known today, about the, you know, causation between illnesses and air pollution and....... you know, lots of information that doesn't suit the agenda of the authorities.

> R: Do you think scientists and doctors know what the effects are?
> Suzanne: yeah
> Jason: I reckon, I reckon, of course they do
> Suzanne: yeah
> Jason: but, but they must, I mean they, they have to keep their mouths shut really
> Suzanne: yeah

> R: do you think that scientists and doctors know enough about how air pollution affects people?
> Mrs Sharma: Oh I'm sure they do, yeah I'm sure they do, but sometimes I suppose whatever they say falls onto the deaf ears, [laughs]
> R: whatever they say to who?
> Mrs Sharma: To the transport or whoever, the government, it falls onto the deaf ears,

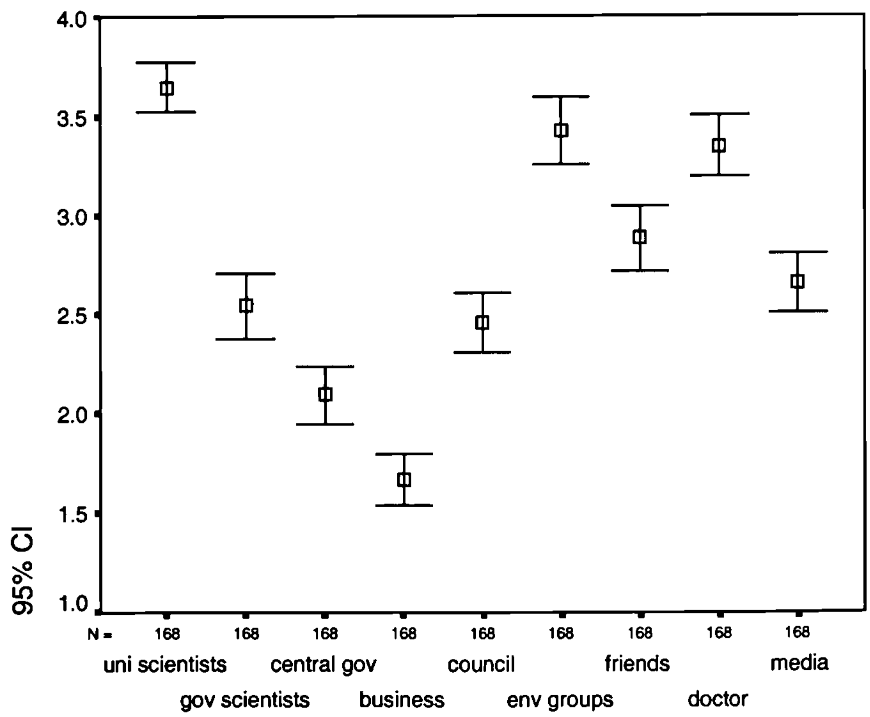
In the questionnaire, people were asked who they would trust to give them reliable information about air pollution and its effects (Q25). For each source listed, they were asked to give a response on a 1 to 5 scale where 1 corresponded to 'would not trust at all' and 5 corresponded to 'would trust completely'. (Note that this is not necessarily related to how often they use these sources, it may be hypothetical). The overall levels of trust indicated were as follows:

Table 6.5: Mean levels of trust in various sources of information, 1-5 scale

Source	Mean level of trust	Std. Error
University scientists	3.67	.06
Environmental groups	3.44	.08
Doctor	3.34	.07
Friends / family	2.92	.08
Newspapers / TV	2.66	.07
Government scientists	2.60	.08
Barnet Council	2.52	.07
Central government	2.17	.07
Business / industry	1.69	.06

A graph of mean levels of trust with 95% confidence intervals appears as follows:

Figure 6.1: Mean levels of trust in various sources of information, with 95% confidence intervals



This shows clear groups in terms of levels of trust. University scientists, environmental groups and doctors are the most trusted – between 'a fair amount' and 'a lot'. These all represent types of expertise, but the interests in which they are working is important. The next group can be taken to consist of friends and family, media, government scientists and Barnet Council. These are all trusted 'a little' to 'a fair amount', although within this group, friends and family are significantly more trusted than Barnet Council at 95% confidence. Central government is next, being trusted a little, and business and industry are trusted the least – somewhere between 'not at all' and 'a little'. The low level of trust in government and industry found here echoes the findings of a recent UK-wide survey about several different risks (Poortinga and Pidgeon 2003). People do indeed appear to evaluate such information not just as facts but also according to their perceived relationship with its source, and the perceived credibility of the source (Michael 1996; Irwin *et al* 1996; Bush *et al.* 2001b).

Grahame Park residents trusted government scientists significantly less than did Totteridge residents (3.47 c.f. 3.8) and Brent Cross residents (3.78). There were few other area differences.

People with children under 16 trusted friends and family less (2.64 c.f. 3.00, $t = 2.536$, d.f. = 175, $p = 0.012$), and trusted their doctor less for information (3.03 c.f. 3.5, $t = 3.077$, d.f. = 181, $p = 0.002$). Trust in doctors for information correlated (weakly) negatively with income (coefficient -0.187, $p = 0.029$). Age correlated negatively with trust in university scientists for information (coefficient -0.175, $p = 0.015$) but positively with trust in doctors (0.181, $p = 0.013$).

Broadsheet newspaper readers trusted central government more for information (2.36 c.f. 2.04 for tabloid readers, $t = -2.104$, d.f. = 164, $p = 0.037$), and also trusted Barnet council more (2.80 c.f. 2.34, $t = -2.948$, d.f. = 166, $p = 0.004$). Similarly, people with higher education (over 'A' level) rated central government information more trustworthy (2.46 c.f. 2.00, $t = -3.241$, d.f. = 188, $p = 0.001$). People with no educational qualifications trusted friends and family more (3.50 c.f. 2.83, $t = -2.923$, d.f. = 178, $p = 0.004$). There would seem to be a slightly higher degree of trust in governmental institutions here among higher educated people, which may be a process of greater identification with the source of information among this group; as Michael (1996) argued, identity is key in the evaluation of information.

There were a few observable associations between suffering from the health conditions in q46 and some sources of information but these did not give a consistent pattern.

6.8 CONCLUSIONS

Lay knowledge is complex. Its formation involves the accumulation and assimilation of different kinds of information from a variety of sources, which include personal experience over time, consultation with experts such as doctors, public information services and institutionally produced information circulated through the media.

As previous research has identified (Bickerstaff and Walker 2001; Elliot *et al.* 1999, Bush *et al.* 2002, 2001b), experiential knowledge produced in the local context is a very important aspect of how people know about air quality. Sensory experience is relied on a lot, particularly smelling pollution, and also seeing pollution, either smoke, haze or dirt deposits on surfaces. This latter point again suggests that people may be more aware of particulate pollution than other less visible kinds. As well as this, people talked about a more general 'feeling' of the air quality, which probably involves a combination of the senses.

Another crucial way in which people become aware of poor air quality is through the physical effects pollution may have. This is especially salient for people who have a health condition that may be made worse by pollution such as asthma or chronic bronchitis. The onset of these symptoms, which they attribute to pollution, alerts them to the actual presence of pollution.

This kind of experiential knowledge formation is linked with different places, but it is highly comparative, as people accumulate experience in different environments and evaluate one against another. This is a particularly interesting geographical way of knowing, linked to different places and contexts but moving beyond the local to a network of locales.

A particular lay knowledge exists around the value of trees and greenery and how this makes the air better. Trees are felt to filter or take in pollution, and to emit oxygen and cleaner air. As well as this, the contribution of trees and greenery to a sense of well-being and health in a wider sense was also referred to many times and this perhaps should not be entirely separated from the more physical explanations of how trees make the air better. This connects very strongly with themes from chapter four about how the nature of the area affects perceptions of the air quality – open space and greenery being a key component here. Overall, the amount of greenery balanced against the amount of traffic in any given area seemed to provide an important rule of thumb by which likely air quality could be estimated.

As well as the physical gauging of pollution levels, as explained in chapter 4 a symbolic level also seems to be in operation. As pollution is connected with busy, crowded, dirty and unhealthy (city) environments where people live a bad lifestyle, so clean air is connected with quieter, more peaceful open spaces with trees around, that give a general sense of well-being. This connects with iconic images of the countryside and more relaxed and healthy ways of living, which extend for example to the pace of life being slower and people being friendlier. It is very clearly relevant to concepts of therapeutic landscapes and the implied corollary of the non-therapeutic or health demoting landscape. This also is part of the aspect of evaluating the (air) healthiness of the different experienced locales over time.

These kinds of lay knowledge are clearly important but from my research it does not seem that people rely quite so heavily as has been suggested on these ways of knowing alone. Knowledge about air pollution as an issue is also acquired from a variety of institutionalised, public sources, including TV, newspapers, magazines, radio and at school. These kinds of sources are most important when it comes to acquiring knowledge about the global aspects of air pollution risk, and about its potential effects. Here the use of a variety of information sources in understanding a largely invisible global phenomenon is much more as Beck (1992) suggested.

These different ways of knowledge assimilation happen at the same time and are not disconnected. The locale-bound experience makes a global risk relevant and everyday, but at the same time the knowledge accumulated through education, TV and any number of such sources over time alerts people to what air pollution is, and why it may be important – it validates, makes sense of and gives a vocabulary to the personal and local experience. Thus mediated and institutionalised knowledge may frame the local and experiential knowledge. Discourses apparently change over time; in this research the global dimension of air pollution risk was linked to the local dimension by the research participants with no prompting; the fact that this has not been shown in previous research is very likely due to more recent media attention to such issues in recent years and particularly the coverage of the Kyoto summit not long before this fieldwork took place.

People also use public air quality information sources, but they don't use them very much. However, in this study they did not rate their own experience as more useful in this context either. It would appear that both kinds of knowledge accumulation are quite passive in the context of air quality. People do not generally actively seek out air quality data, but may come across it on weather forecasts. Similarly, with respect to their own experience, they may not actively ask themselves how the air quality is most of the time, but may be prompted to notice sometimes that it seems especially good or bad. The people who were more likely actively to construct knowledge in either way were those with affected medical conditions, and again they did not strongly favour one way of knowing over the other.

In terms of knowing about the health effects of air pollution, some knowledge was again acquired through experience. The experiences of close friends and family were particularly important here. An epistemology based on observation over time of a small number of people often led to beliefs about the health effects; this epistemology of lay epidemiology could be incompatible with classical epidemiological epistemology and has been observed before in being at the root of conflicts (Williams and Popay 1994; see also Wynne 1992a, 1996).

People also use common sense and make links between air pollution and other more known substances such as cigarette smoke. This common sense kind of knowledge did not involve reference to expertise although it did involve a basic kind of knowledge of science and so was not 'anti-science'. Common sense knowledge with regard to health effects was perhaps stronger than with regard to other issues such as air pollution patterns.

Nevertheless people often do not express certainty in this kind of knowledge. Alternative explanations were often offered and as Moffatt *et al.* (1995) observed, unease rather than conviction characterised the expressions.

In the face of this uncertainty, most people felt that science would be the way to better understanding. Although perhaps unconsciously using a different epistemology themselves, the status of science as the best way to achieve correct understanding was generally subscribed to and instances of scientific method using large populations and statistical measurements were cited as examples. Thus there was little evidence of epistemological alienation; at the moment air pollution is not an issue where much conflict has occurred. However the epistemological disjuncture between the formation of some of the lay knowledge, notably about the health effects, and classical epidemiological method involving larger sample sizes could be a potential fault line along which conflict could erupt, if institutional knowledge were to come to a point of being at odds with such lay common sense knowledge. In such a case, alienation and the importance of identity in choices about trust and judgements of knowledge validity would almost certainly become more visible phenomena, in the kind of sense that Wynne (1992a, 1992b, 1996) described.

As science was seen as currently the best method, so people wanted more scientific knowledge given to them in understandable terms. This came across very strongly and in fact one could say that the participants in this research seemed to be employing a 'deficit model' (Irwin 1995) of the public understanding of science. Certainly it was not felt that the public in general know very much about air pollution and its effects; some felt that people are not interested, whilst others thought they just needed more education about the issue. Favoured ways of getting more relevant information to the public were through media and by leaflets to householders, and such informing was generally felt to be the responsibility of the government or council. The desire on the part of the public for more expert-produced information to help them understand the risk is again similar to the analysis of Beck (1992) and Giddens (1991) and could be seen in Giddens' terms as a kind of 'reskilling' by re-appropriation of information.

The portrayal of science was as a force for the good and as value neutral. Iconic images were evident here also in such discourses about science and scientists. Trust was an important issue but science as a project was generally trusted. Distrust came in in the institutional context of scientific research, academic scientists being more trusted than government scientists for instance, which is a not uncommon finding (e.g. Poortinga and Pidgeon 2003). This does not completely concur with Layton *et al.* 1993 (cited in Irwin 1995), that people generally see science as inseparable from social and institutional concerns; theoretically the two are separated, but in practice these concerns do come to bear. The agendas of policy makers not just in their management but also in the information given to the public were called into question. Government were trusted slightly more by the more educated. Least trusted in this context however were business interests, due to their economic investment. Thus as Irwin Dale and Smith (1996) and Michael (1996) saw it, people are not assimilating information passively, but do reflect on its status, in terms of the social relations of its dissemination, although I would disagree with Michael (1996) and Bush *et al.* (2001b) that this is exactly a reflection on its epistemological status.

CHAPTER 7

Conclusions

This chapter draws conclusions regarding the research questions set out at the end of Chapter 2, in the light of the empirical study. First I draw conclusions regarding lay knowledge of air pollution, its nature and its effects. I reflect on what the study has shown regarding the role of context, regarding concepts of environmental equity/ justice, and regarding the relationship between lay knowledge and expertise. I then make some final conclusions regarding the role of different paradigmatic approaches to environmental risk and reflect on the use of mixed methodology in addressing the aims of the research. As a last point, I consider some policy implications to have emerged from the study's conclusions.

7.1 PERCEPTIONS AND UNDERSTANDINGS OF AIR POLLUTION AND ITS CAUSES

Broadly speaking, people's perceptions of relative air quality are in line with the scientifically modelled levels. This is probably because the causes of air pollution identified by the public are also in broad agreement with science, and people use this knowledge at least in part to work out where air pollution is located.

Traffic was identified as the main source of air pollution, and within traffic, buses and HGVs were thought to be particularly polluting. Thus areas of poor air quality were identified as being main roads, particularly where or when there is congestion, and central London, where there is a lot of traffic and where taller buildings prevent pollution being dispersed quickly.

As well as identifying causes of pollution however, many people identified trees as a countering factor. This was very widespread and powerful. Trees were thought to filter the air or 'suck up' pollution, and to produce oxygen which makes the air better, and more healthy. In addition, in a more general sense, being around trees and greenery provided many people with a sense of well-being and acted as a countering factor to the stresses of spending time in built-up, crowded and polluted areas.

In perceiving levels of ambient pollution in any given place, people made a lot of use of sensory experience, particularly smell (as found by Elliot *et al.* 1999; Bickerstaff and Walker 2001; Medalia 1964; Wall 1973; Thouez and Singh 1984); they also gauged levels of pollution by noticing the visible deposits on surfaces such as windows and cars. This could potentially lead to a tendency to detect particulate pollution more than other types of pollution, but as particulate levels are normally related to levels of nitrogen oxides, and these are the two main pollutants of concern in this context, this way of identifying pollution is reasonably effective. Ozone, which is potentially a health risk particularly for asthmatics, may be more of a problem for people to identify however.

Another way in which people detect pollution is by the physical effects it has. People with asthma and allergies in particular might notice the effects on those conditions, but many people cited that they felt shorter of breath when they thought air pollution levels were high.

These are very personal and experiential ways of knowing, and they are important, but they were not the only ways in which people formed knowledge about air pollution. Air pollution as an environmental issue, particularly in its global context, was learnt about through TV, newspapers and other formats in the public domain. In this I do not entirely concur with Bickerstaff and Walker (2001) or with Bush *et al.* (2001b; 2002) who argue that the local context is much more important in how people understand and form knowledge about environmental risks in general, and air pollution in particular. In this study it emerged that the global aspect of air pollution was particularly important to people and if anything was seen as more important than the local. In understanding the risk at this scale, the media was very important.

People did not on the whole make much use of air quality information services such as those in newspapers and on teletext; the most used was information on TV weather forecasts but for many people this was passively, as they happened to see it, rather than because they were positively seeking out the information. However, when asked comparatively, people did not seem to rely on their own experience more either. This may be because in general people did not feel air quality to be something that they could do much about or which affected them particularly (see also Bush *et al.* 2001b), unless they had a particular medical condition to which it made a large difference.

7.2 PERCEPTIONS OF AIR POLLUTION, HEALTH AND RISK

Air pollution was definitely thought to be a health risk to the general public. A majority of people taking part in the research thought that air pollution could cause the onset of asthma, chest problems and rhinitis type allergies. To a lesser extent, people thought that air pollution might cause skin complaints, heart problems, and developmental disorders in children or memory problems in older people. These beliefs were nevertheless not characterised by conviction; people also offered alternative explanations for these conditions and in the interviews expressed a significant amount of uncertainty.

Air pollution was also thought to make existing health conditions worse. Again, the conditions which were thought to make people more vulnerable to the effects of pollution were asthma and chest complaints, and rhinitis type allergies including hayfever. This is very much in line with current medical knowledge (see chapter 1 section 1.4) However there was something of a gap between medical and lay knowledge regarding heart disease. According to current epidemiological and medical research, heart conditions are among those most affected by air pollution and it is through the effects on the heart that a substantial proportion of the hospital admissions and deaths brought forward due to air pollution occur (Dept of Health, 1998; 2000). In this study however, heart conditions were less mentioned in terms of causing vulnerability to air pollution, and heart disease sufferers on the whole did not appear to feel themselves as affected by air pollution as did those with chest and allergic complaints. There is the possibility of a type 2 error in the quantitative data with respect to this as the sample is small and the number of heart disease sufferers low; nevertheless heart disease was little mentioned during the qualitative interviews.

As well as specific complaints, people interviewed and surveyed thought that air pollution was bad for people in a general systemic way, and that it may for instance shorten life expectancy for people who lived a long time in polluted environments. Again, this would be corroborated by some medical research (WHO 1999; Dept of Health 2000). It was also thought to contribute to fatigue and general feelings of being in less than perfect health. One concern was that air pollution might 'tip the balance' and contribute to the causation of problems such as cancer when in combination with, or added to, other environmental hazards. This is an important point as it shows people seeing their environment as a whole in terms of health risk, whilst medical and epidemiological methodology strictly separates out separate risk factors in order to apportion relative risks to each (although interaction effects are conceptually allowed for but again apportioned a quantitative amount of risk). Epidemiology tends to compare risks, while people add risks. Thus medical experts might make a comparison between the health risk from air pollution and the health risk from smoking, and reason that someone who is prepared to take the risk of smoking should not reasonably be worried by the far smaller risk from air pollution. The smoker, however, is more likely to feel that the two risks added together are too great, and so be unwilling to take the extra burden of air pollution.

Twenty eight per cent of respondents to the survey thought they had a health condition which had been caused by air pollution. These were mainly asthma and chest problems, and rhinitis type allergies.

Thirty six point five per cent of respondents to the survey claimed to have a health condition they thought was made worse by air pollution, and 14.5% didn't know – this is notably high. 57% of people thought that the health of some of their family and friends was definitely affected by air pollution – also notably high. Again, the main conditions cited here were asthma and chest problems and rhinitis type allergies, with skin problems less so, but noticeably making an appearance. Part of the reason for hayfever and rhinitis sufferers feeling affected could possibly be accounted for by respondents counting pollen among air pollutants, but it was also clear from the interviews that many people felt that exposure to chemical air pollution made other allergies worse. This would be corroborated by some scientific evidence (e.g. Takano *et al.* 1997; Miyabara *et al.* 1998; Knox *et al.* 1997).

It was important though that the extent to which people felt affected in terms of specific health effects did not vary significantly between the respondents in different areas. This would suggest that the experience of air pollution in terms of its felt effects is not driven by the level of pollution, either measured or perceived, in the areas in which people live. The interviews in particular showed that people experience air pollution in a wider geographical sphere in their day-to-day lives, including where they go to work and shop and for social activities, and their journeys to these places.

People's knowledge about the health effects of air pollution was formed often in a 'common sense' way, and particularly by observing the health of people close to them, and making connections between this and the physical environment. Comparisons were important in how they themselves and their family felt between different places of varying air quality. Here, what may be seen as 'lay epidemiology' is employing a different epistemology from medical epidemiology, lay knowledge relying on a smaller number of case studies observed over time, and also sometimes incorporating anecdotal evidence from others, and using common sense reasoning as to why these effects might occur. This is the kind of epistemology that Williams and Popay (1994) described and saw as a potential epistemological challenge to science, as well as a political one.

Nevertheless, despite a fairly coherent lay epidemiology or lay aetiology emerging, as noted above it was characterised by uncertainty and a degree of deference to expert medical knowledge, which I will discuss further below.

7.3 THE ROLE OF CONTEXT

In the conceptualisation of this thesis, I was interested in the role of social and geographical context in public understanding and experience of air pollution.

Social and geographical contexts had an important role to play in peoples understanding and experience of air pollution. In the final analysis is hard to separate out these kinds of context, as social circumstances lead to choices, or lack of choices, about where to live, and geographical location may bring with it a range of social problems, which are part of the context of the 'neighbourhood'.

Nevertheless, there were ways in which geographical context was particularly important. People's perceptions of their local air quality, although largely based on physical assessment of the detectable levels, as discussed above, were also to some extent influenced by other factors about where they live. In the better-off, desirable neighbourhoods of Totteridge and Hampstead Garden Suburb, people cited many good points about the areas and considered them to be overall quite healthy. This was largely connected to the amount of open spaces and greenery around, but also included physical security and good relationships with neighbours. In Totteridge, this meant that air quality could be praised as very positive, and in Hampstead, although air quality was acknowledged as being bad on the main road, it meant that overall people could still see the area as a good place to live and could even cite the air quality in the neighbourhood as a whole as good, confining the pollution to a narrow geographical area. In Grahame Park, however, an overall dissatisfaction with the area meant that people did not talk about the air in positive terms although the presence of pollution was not discussed. Analysis of the survey data indicated that perceptions of poor air quality might be related to perceiving a range of physical and in particular social problems in the neighbourhood. Thus expressions of pollution and poor air may to some extent reflect an overall dissatisfaction with a place, as suggested by Irwin *et al.* (1999), whilst a high level of satisfaction with the residential area may lead people to downplay a negative aspect (see also Bickerstaff and Walker 2001).

This can also be interpreted in 'landscape' terms (Curtis 2004; Curtis and Jones 1998). People's understanding, perceptions and assessment of air pollution as a hazard and as a health risk reflected their own conceptions of the healthiness of a place in terms of an ecological landscape (the physical presence of pollution and its geographical distribution), a material landscape (e.g. housing standards, overcrowding, litter and amenities) and a symbolic landscape (the therapeutic power of nature). These landscapes were overlain and elements of each woven together. Sometimes one could compensate for another, so for example Hampstead Garden Suburb's material and symbolic strengths meant that it could be seen as quite healthy, despite its acknowledged weaknesses as an ecological landscape, in terms of the level of pollution.

Thus the characteristics of an area may act as a kind of buffer to the experience of an environmental risk or problem. In Hampstead Garden Suburb, people acknowledged the presence of pollution, and in fact a set of problems which stemmed from living on a main road, but felt the impact less because they were able to escape from it into their larger houses, and most importantly, into their gardens and the open spaces around. These gardens and open spaces allowed them to relax and feel a sense of well-being and peace. In this way, living in a certain level of pollution was made more bearable.

I also argued in chapter 5 that people's important experience of air pollution and its effects does not necessarily take place where they live; certainly place of residence was not related to how much people felt their health was affected. Thus the residential neighbourhood can also act to buffer or compound the effect of the risk that is experienced over the course of the day in different places. Living in a neighbourhood which is green and peaceful and feels healthy, such as Totteridge, allows people to recuperate from the experience of the polluted environment of the city where they may have spent their day and where their experience of air pollution may take place. Such neighbourhoods may be seen as therapeutic landscapes, incorporating both material and symbolic elements, which combine to promote a sense of well-being. This case study provides an example to echo the point made by Wilson (2003), that the idea of the therapeutic landscape may be just as relevant to people's everyday geographies as to special sites of healing such as spas or places of pilgrimage.

The above points can be categorised as contextual effects, in terms of geography, whilst this study revealed other kinds of effects on peoples perceptions that could be categorised as compositional in terms of each study area – i.e. they were more to do with individuals' circumstances, although the characteristics of individuals as a population varies between different areas.

The empirical results of the study show that the factor connected with people's personal circumstances which had the most direct influence on perceptions of air pollution and on perceptions of the health effects, was whether or not they suffered from medical conditions of the lung, or rhinitis type allergies (including hayfever). People who suffered from such conditions were more likely to perceive air quality as worse, were more likely to feel personally affected by air pollution, and were more likely to make some kind of behavioural change or take some kind of avoidant action as a result. They were also more likely to feel they could personally tell when air quality was bad, and were more likely to use some sources of air quality information.

Individuals in better economic circumstances also emerged as somewhat protected from air pollution as an unpleasant experience and as a health risk, in that firstly they are more likely to be able to get away from the polluted environment sometimes by taking more and longer holidays than those in poorer circumstances (as indeed some of them pointed out), and secondly that they perceive that they are living there by choice, and that they could make a different choice if they wanted to, or could move if they felt they needed to. This was expressed by most of the Hampstead residents in the interviews.

Other social factors, such as gender, education levels, occupation and length of residence, in this study had little relationship to perceptions or attitudes despite having been shown to in various previous studies, though admittedly with little consistency. A group of people characterised by professional job, higher income and broadsheet newspaper reading however were likely to feel more strongly that experts do not know enough about air pollution, and neither do the general public. Broadsheet newspaper readers also trusted both local and central government more for information – possibly due to identity processes important in judgements of trust (see Michael 1996; Wynne 1992b).

There were also ways in which personal circumstances and neighbourhood effects can be seen as interacting. People in the less well-off areas did not prioritise air quality as a neighbourhood concern, because they had other things to worry about, particularly in Grahame Park where drugs and housing conditions were major worries and where the air was not seen as particularly bad. In this way, greater social deprivation both individually and in area terms is likely to lead to less relative concern over air quality. It did not however seem to lead to less actual concern. People in less advantaged circumstances however exhibited more fatalism and resignation to the problem, and were more likely to feel that they could not do much, and that they had other more pressing things to worry about.

7.4 IMPLICATIONS FOR ENVIRONMENTAL EQUITY

In chapter 2 I argued that environmental equity studies, by concentrating on mapping ambient pollution concentrations against where people, categorised by variables such as socio-economic status, live, give only a partial picture, and that this lacks information about how people experience the risk and the burden.

The implication of the usual kind of study design, by looking at pollution against poverty and socio-economic status, is that it is unfair for poorer people to suffer a greater amount of the risk. Clearly this is unfair in that it is unequal – it is unfair for anyone to suffer a greater amount of the risk. This is implied by use of the term equity. However it is also implied in the conceptualisation of these studies that it is more unfair for poorer people to suffer more of the risk. This is perhaps better covered by use of the term environmental justice.

This early work however does not really make it conceptually clear why it may be more unfair for poorer people to suffer more of a risk – one interpretation is that this is because they already suffer more burdens and problems socially, economically and environmentally, and adding another burden is therefore more unjust than it would be if the burden were placed on people who are more advantaged in other ways.

This study identifies three pathways by which environmental injustice may operate with respect to the experience of air pollution, in that more disadvantaged people may suffer a greater burden even at the same given level of pollution.

First, people living in poorer environments may perceive air quality to be worse, because their feelings about the air reflect and reinforce a general sense of a poor environment, both physically and socially. This is one sense, in a symbolic way, in which poor air might be a greater burden to poorer people, or people in more deprived neighbourhoods, than to more advantaged people.

Another and probably greater way in which geographical context is relevant to environmental justice concepts is that people living in neighbourhoods which are physically advantaged, particularly by gardens, open spaces and trees, are to some extent buffered from the experience of air pollution as an environmental risk. This is another way in which it may be more unjust for socio-economically disadvantaged people to suffer a greater amount of pollution, as they are more likely to be living in a physically disadvantaged area, and therefore be less protected from any given level of pollution.

Thus to link this to the idea of 'landscapes' of health, environmental injustice may be played out not just through the ecological landscape (in terms of pollution distribution) but also through the interaction of this with the material and symbolic landscape.

The third way in which the burden of air pollution might be greater for more deprived communities is related to their economic circumstances and operates at a more individual level. This is through the important concept of choice, as McLeod *et al.* (2000) and in particular Mitchell and Dorling (2003) raised. Socio-economically advantaged people may sometimes suffer a relatively high amount of residential air pollution, but such people may be doing so by means of a positive choice, because they value other aspects of their location. In Hampstead Garden Suburb for example, many people expressed their choice to live there as an economic weighing-up of the costs and benefits. The benefits included good schools, nice houses for a lower price than they would be had they not been located on the A1, and somewhat ironically, a nice environment. The main road was a source of nuisance, but this was compensated for by having gardens and open spaces around – this ties in with the above point about the physical environment enabling them to experience the nuisance less. In Brent Cross, by contrast, people had been housed there by the council and had often been there for a long time. Although most residents were happy there, they also had less opportunity to move. Thus they expressed resignation about poor air quality.

So these are three ways in which, taking the experiential view, it can be seen that placing a greater burden on people already socio-economically disadvantaged may be the most unfair situation. This is in addition to the political points of the original environmental justice movement, that these are people who are traditionally disenfranchised, have the least input into the decision-making process, and already have a lot of other things to worry about. To put this view another way, it is also the case that a given level of risk will likely be felt more by socio-economically disadvantaged people, and this is partly through geographical processes[11]. Thus the concept of environmental equity, in implying equal distribution as the logical solution, may be less adequate than a concept of environmental justice, in addressing these points. Equal distribution does not necessarily mean equal burden, a point which the usual mapping-based studies do not take into account. Alternatively, Cutter's (1995) definition conceptualising equity as equal effects is useful, but studying effects must involve more diverse methods to complement those in the traditional mapping studies.

[11] The situation may of course occur where a socio-economically deprived community is not so exposed to these geographical contextual factors, for example in rural areas.

However, there is another important dimension relevant to the study of environmental equity brought up by this study. Looking at the experience of health effects, it emerged that the experience of adverse health effects of pollution did not seem to be driven by residential pollutant concentration. People seem to experience air pollution in a much wider sphere than where they live. In particular, places where they regularly go to work, to shop and for leisure activities featured prominently in accounts of their experience of air quality. Thus mapping residential exposure in order to understand risk burden may be missing this important point. This has important policy implications because it implies that overall reduction of pollution, particularly in the most polluted places, may have the greatest benefits for all, including the most disadvantaged, regardless of where they live.

Nevertheless residential environment, as I argued above, is still important. Wherever people experience air pollution, being able to come home to a peaceful, secure, place with open spaces, trees and good air, helped them to recover both physically and mentally, and helped them to be able to bear the risk overall. This situation though would obviously be improved were their environment throughout the day optimally pleasant. Thus people living in a physically pleasant neighbourhood are still advantaged in terms of air pollution risk, even if it is not residential exposure which is most salient in terms of how they experience the risk. These concepts need more following up as there is a tension between the two.

Lastly, there is an important point in terms of environmental equity or justice about how to conceive vulnerability. As I have explained, there are good reasons to conceive the most vulnerable people in terms of air pollution as being the socio-economically disadvantaged. However in this study, it emerged that arguably the most important factor directly influencing experience of air pollution was medical status, in terms of being prone to asthma, chest complaints, rhinitis type allergies and to some extent skin irritations. Heart problems did not emerge as so influential in people's perceptions of the effects but medically they are seen to be so. Thus these people may be suffering the greatest burden, medically, emotionally and in terms of needing to modify their behaviour, at any given level of pollution, regardless of their socio-economic circumstances. Elderly people and young children are also at more medical risk, as Brainard *et al.* (2002) recognised in their study. These categories could therefore be a useful alternative conceptualisation in examining environmental justice in studies of the distribution of, and exposure to, air pollution.

7.5 RELATIONSHIPS BETWEEN LAY AND EXPERT KNOWLEDGES

People formed their own knowledge of air quality and its effects in large part through their own experience and that of people close to them, both in their everyday environment and by making comparisons with experiences in other places. This is a particularly geographical way of knowing, and the situation of such lay knowledge within the context of place has been argued by some to be a particularly local knowledge of air quality (Bickerstaff and Walker 1999a, 1999b, 2001; Bush *et al.* 2002, 2001b).

This is not however the only way in which people's knowledge of air pollution and its effects is formed. People assimilate knowledge about air pollution, its causes and its effects, especially environmental effects, from a mixture of public sources including TV, newspapers, magazines, and at school. They did not, in this study, use public information services specifically about air quality to a great extent. Those that did so the most were people who felt their health was affected. Nevertheless they did not rate their own experience as more useful than the most used information sources either.

People's knowledge about air pollution, therefore, is a mixture of common sense, observation and information produced by experts and distributed largely through various media. Because air quality is not an issue of pressing importance to many people, and perhaps because they feel they cannot do much about it, much of this information is acquired quite passively. People may use different types of knowledge more or less in different circumstances, for instance they may be alerted to the immediate presence of pollution through smell or sight, but in the context of knowing about the long-term global effects of air pollution they are inevitably more likely to cite things they have read or seen on TV.

One important reflection here is about epistemology and ownership of knowledge. Wynne (1992a, 1992b, 1996), as I discussed in chapter 2, argued that there can be an epistemological disjuncture between embedded local knowledges and (supposedly) abstracted expert knowledges which can lead to alienation of lay people, as their knowledge, which reflects values and sets of social relations, is devalued. This study found that there may indeed be a difference between the kind of epistemology people use in forming their own common sense understanding of the health effects of air pollution for instance, but found no evidence of a sense of alienation by expert systems of knowledge. On the contrary, people were less than totally confident in their own knowledge and often cited scientific epistemology and methodology as the best way to know about such things.

Air pollution as a risk has not been to date an area of conflict. Perhaps if there were to emerge a conflict over the considered health effects, as for instance in the case of the Camelford poisoning (a public health case cited by Williams and Popay 1994), this potential fault line would become more salient. Were Wynne's analysis correct, the public might not necessarily see it in those terms. It is, though, this lack of present conflict which is part of what is interesting about air pollution as a case study of environmental risk, as much of the literature on social theories of risk, and indeed on lay epidemiology, has been built on analysis of situations of conflict.

At present though, on the evidence from this study, it would seem that the situation is closer to how Beck (1992) for instance may characterise it. People do have their concerns and worries about air pollution and its effects on both public health and the environment. These include social values, and many people want the public to be involved in decision-making. At the same time though, most people felt the need for the public and themselves to be more informed by experts, and particularly by scientists, in order to be able to understand and evaluate the situation better. This was reminiscent of Giddens' (1991) concept of 'reskilling'.

This is not to say that people trust experts blindly. Indeed, participants in this research would evaluate the sources of any expert knowledge in terms of its perceived interests, and past experience of its trustworthiness. Michael (1996) and Bush *et al.* (2001b) saw a similar phenomenon as people reflecting on the epistemological status of expert knowledge. I do not think the participants in this study would agree with this: it seems to me that people are happy with the epistemology but sceptical of knowledge interests, and crucially, they see these things as separate. This separation of the ideal of science from the context of its production and dissemination is perhaps key; commentators such as Latour (1983; 1992), Wynne (1987, 1992a, 1992b) and at times Williams and Popay (1994) are precisely arguing that the social context of knowledge production *is* an epistemological matter, shaping the nature of the knowledge produced. The public view of science as a knowledge system however appeared in this study as neutral and value free. Distrust was located in political and economic agendas. These political agendas in particular could be seen to make the science disseminated less trustworthy, as in the case of government scientists being trusted less than university scientists, but the distrust did not reach as far as scientific epistemology – its seemed more a question of possible distortion or partial reporting of research findings. Perhaps however, in the end the distinction between the two views is not so great, as people's concept of pure science was abstract and academic, and in practice the context of the production of science was most salient to them.

7.6 PARADIGMATIC APPROACHES TO RISK AND ENVIRONMENTAL HAZARD

Social theories of risk have taken different positions between naïve realism and strong social constructionism, with correspondingly different insights, as discussed in chapter 2. Naïve realist / positivist approaches have taken a technical science-centred view and emphasised the (potential) measurable harm done, and these have been criticised for missing the social and cultural context of risks, and for not acknowledging the role of personal and social values in people's judgements about risks. The most constructionist theories on the other hand, such as that of Douglas (1970, 1985) and of Wynne (1992a, 1992b, 1996) have offered valuable insights into the role of culture and social identity processes in public constructions of, and reactions to, risk, but have been criticised for downplaying the real, physically damaging potential of environmental hazards (Kaprow 1985).

This tension between paradigmatic approaches is clear in reviewing work on perceptions of air pollution. Most of the early work from the 1960s to 1980s took a fairly naïve realist view and measured perceptions of air pollution levels in relation to an assumed scientifically measured reality. As such, conceptions of the social dimension of risk perception were weak. In later work however a turn towards a more constructionist stance is apparent (e.g. Bush *et al.* 2001a; Bickerstaff and Walker 2001; Howell *et al.* 2002, to varying degrees), but some potentially valuable arguments regarding the social, psychological and cultural significance of risk perceptions have been weakened by not addressing a physical dimension to hazard exposure (see section 2.4.2).

Moffatt *et al.* (1995) argued that in understanding situations of environmental health risk, both medical /scientific and social /constructionist viewpoints may be needed, and I would strongly concur. In this study, both material and symbolic levels seemed to be in operation simultaneously in peoples understanding of, and talk about, air pollution, much as in Whittaker's (1998) analysis of an environmental threat. In judging air quality, for example, people were responding to physical levels of pollutants, but they were also expressing levels of satisfaction or dissatisfaction with other aspects of the neighbourhood. The physical aspect was important in people feeling the effects of pollution and wanting to know more about how air pollution could affect them medically. The symbolic was in operation in people expressing poor air as part of a collection of symptoms of an unhealthy environment which extended to a way of life, epitomised by the city of London, whilst clean air was associated with and symbolised a healthy, natural, green environment with better social values and a better way of living.
It is therefore key in understanding environmental risk situations to be able to use both perspectives to give insights. The physical aspects of hazards and risks both in terms of exposure and consequences cannot be ignored and judging potential harm in quantitative

and relative terms is part of how people process risk. At the same time risks clearly have psychological, cultural and symbolic meanings that go beyond this. In understanding and acknowledging the contribution of each aspect, the other can also be better evaluated and understood.

7.7 METHODOLOGICAL REFLECTIONS

The use of a mixed methodology to explore perceptions of air pollution and its effects I feel was beneficial.

On retrospective reflection, I would agree with Sale *et al.* (2002) that using two such methodologies together should not be seen strictly speaking as triangulation, as the two methodologies do not (fully) access the same phenomena.

The semi-structured interviews were particularly strong in accessing the symbolic aspect of people's feelings about air pollution. Indeed they were good for accessing feelings about air quality and the neighbourhood environment, and for building a rich sense of context. It was also in these interviews that more nuanced understandings could be reached, for instance it was here that people expressed uncertainty about their opinions of the health effects of pollution, uncertainty which did not emerge in the more constrained format of the questionnaire. In the interviews people were able to express sometimes paradoxical and conflicting views and to move between alternative accounts. Interviews offer time and space for people to reflect on what they are saying, and they capture this reflection.

The questionnaire had a basic strength in reaching more people. The interviews might offer deeper insights but they could not do so for a good sample in each neighbourhood, at least not within the resources of this study. The questionnaire also had a particular strength in allowing the analysis to look for relationships between variables, which was very important in looking at how for instance people's perceptions of how pollution affected them was related to where they lived. Of course these kinds of relationships in the data need careful and sensitive interpretation, as always. Basing the questionnaire in themes and even wording which had emerged from the interviews increased its strength and allowed these emergent themes to be explored further, in a certain kind of way.

Both methods to some extent help constitute the results that emerge. The interaction situation of the interview shapes the conversation somewhat and its format pushes people to explain and reflect and to verbalise, and the style of analysis categorises into themes taken out of context of the conversation, although good analysis should be sensitive to these issues. The format of the questionnaire constrains answers and people react to this in a certain way. I would go so far as to say that people may exhibit more of a contextualised way of knowing in the interviews, and when faced with the questionnaire will evaluate and express their views in a more abstracted, pseudo-scientific way – for instance when asked to evaluate local air quality - as people were clearly capable of both ways of thinking.

The use of both methods together, although as I said should not be strictly speaking seen as triangulation, makes the analysis stronger. Themes emerging in the interviews can be extended by the questionnaire and tested to see how widespread or variable they are. Relationships observed in the survey data can be reflected on by turning to the interview data, to understand why they might be occurring or what if anything they signify.

This use of mixed methodology has great benefits for policy research. The expansion of the sample by use of the survey gives breadth and legitimacy, whilst the interview data allows a deeper understanding of the meanings and values behind people's attitudes, opinions and behaviour. The use of both together allows exploration of both the constructed, symbolic realm and the more realist, material assessment of environmental and / or geographical situations, both of which people use.

7.8 POLICY IMPLICATIONS

It has not been focus of this thesis to formulate policy solutions to the air pollution problem; nevertheless the research was conceived partly in response to the current attention being given to air quality regulation, and its conclusions contain some important policy-relevant points.

It seems that the best way to benefit most people, and to benefit the most disadvantaged people, would be to reduce overall pollution as much as possible, wherever it is. If attention should be given to particular areas, it should be those most polluted and most frequented. Residential pollution concentration does not, from this study, provide a good indication of how much people experience the impact of air pollution, particularly in terms of health effects. Places where people shopped and worked were some of the most mentioned in terms of where the effects of pollution were felt.

The people that feel the greatest effects from air pollution and who appear the most vulnerable are those who have medical conditions likely to be affected, especially asthma, chest problems and allergies. Children and the elderly are also likely to feel the impacts more. Policies aiming to protect the most vulnerable should therefore take these categories into account, rather than, or as well as, concentrating on socio-economic categories.

However, this study showed that geography affects how people experience air pollution through different pathways, and policy should pay attention to, and work with, these pathways. Thus as well as addressing the ecological landscape of air pollution distribution, peoples experience of air pollution can be alleviated by attention to the material and symbolic landscape also. It emerged clearly that people's experience of poor air can be greatly relieved by a pleasant overall environment, and most particularly by the presence of trees and greenery. This provides both physical and psychological benefits and promotes a sense of health and well-being. Thus residents in areas such as Brent Cross, which experience high levels of pollution and where few people have gardens, would benefit enormously from for instance the planting of trees along the roadside where possible (a suggestion which some residents have already made to the Council) and the provision of as much landscaping as possible. The cultivation of trees in any highly polluted areas, whether residential or not, would be of great advantage, for the reasons argued above regarding where people experience pollution. Possibly a little harder to tackle are other elements of the physical and social environment such as housing standards, population density and crime, but nevertheless in places where regeneration is due to take place, such as Grahame Park, the benefits may well spread to decreased perception of all kinds of environmental bads including those not directly addressed.

People do want more information on air quality and how it may affect them, and the majority felt that citizens ought to be involved in decision-making. At present, publicity in Barnet does not seem to be reaching many people. TV, radio, local papers and information leaflets through the door would appear to be the best way to reach people; the latter two may be more feasible for local authorities. As the global dimension to the environmental risk from air pollution seems to have become more salient in the public consciousness, information that makes the links between the local and global aspects of the production of air pollution and its effects is likely to be more successful and meaningful.

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APPENDIX 1: UK AIR QUALITY OBJECTIVES

Current UK air quality objectives under the 2002 Air Quality Regulations are as follows:

pollutant	concentration	Measured as	Achieved by end
Benzene - all authorities	16.2 $\mu g/m^3$ (5 ppb)	Annual running mean	2003
Benzene - England and Wales	5 $\mu g/m^3$ (1.5 ppb)	Annual mean	2010
Benzene - Scotland	3.25 $\mu g/m^3$ (1 ppb)	Annual running mean	2010
1,3 butadiene	2.25 $\mu g/m^3$ (1 ppb)	Annual running mean	2003
Carbon monoxide (CO)	10 mg/m^3 (8.6 ppm)	Running 8 hr mean	2003
Lead	0.5 $\mu g/m^3$	Annual mean	2004
Lead	0.25 $\mu g/m^3$	Annual mean	2008
Nitrogen dioxide (NO2)	200 $\mu g/m^3$ (105 ppb)	1 hour mean, not to be exceeded more than 18 times a year	2005
Nitrogen dioxide (NO2)	40 $\mu g/m^3$ (21 ppb)	Annual mean	2005
PM10 - all authorities	50 $\mu g/m^3$	24 hour mean, not to be exceeded more than 35 times a year	2004
PM10 - all authorities	40 $\mu g/m^3$	Annual mean	2004
PM10 – Scotland only	50 $\mu g/m^3$	24 hour mean, not to be exceeded more than 7 times a year	2010
PM10 – Scotland only	18 $\mu g/m^3$	Annual mean	2010
Sulphur dioxide (SO2)	350 $\mu g/m^3$ (132 ppb)	1 hour mean, not to be exceeded more than 24 times a year	2004
Sulphur dioxide (SO2)	125 $\mu g/m^3$ (47 ppb)	24 hour mean, not to be exceeded more than 3 times a year	2004
Sulphur dioxide (SO2)	266 $\mu g/m^3$ (100 ppb)	15 minute mean, not to be exceeded more than 35 times a year	2005

$\mu g/m^3$ = microgrammes per cubic metre
ppb = parts per billion
ppm = parts per million

Source: Air Quality Management, http://www.air-quality-management.co.uk

APPENDIX 2: THE IN-DEPTH INTERVIEW SCHEDULE

NB – this was designed to be used flexibly and provided a guide and a list of possible questions, rather than a list of questions to be strictly followed in the same order in every interview.

How long have you lived here?
Can you describe your neighbourhood to me?
How do you like living here?
Can you say what you think are the best and worst things about the area?
(what changes would you like to see?)

Do you think that it is a healthy place to live? Is that something that you ever think about?
(If I ask you to think about it now, what would you say?)
What could be done to make it a healthier place to live?

One aspect that I'm particularly interested in is air quality, or air pollution.
(When I say air pollution, what kinds of images or thoughts come into your head? Anything at all that you think of.)
What places would you think of as having bad air quality?
What places would you associate with clean air?

In terms of your everyday life, or places you often go, do you notice any differences in the air quality in different places?
What do you think the air quality is like around here?
(what makes you think that?)
Are there any places round about where you think it is better or worse?
How do you explain that?
Have you noticed any changes over time?

Are there any times when you think it is better or worse?
How do you know when its better or worse?
What kind of situation might make you think about the air quality?
What kind of thoughts would go through your head?
How often does that happen?

What would you say air pollution is? Where do you think it comes from?
Who do you think causes it?
(how do you feel about that?)

How do you think air quality or air pollution affects you?
Are people that you know, say your family and friends, affected in any way by air quality?
Do you ever talk to people about it?
How do you think air pollution affects people in general?
(What kind of people do you think might be affected by air pollution?).

Do you think the effects of air pollution are known?
(do you think that scientists or doctors know enough about the effects of air pollution?).

Do you remember when you first became aware of air pollution as an issue?
How did you become aware of it?

Have you ever been to the doctor with any problems you would connect with air pollution?
If so, could you tell me something about what happened?
If not, do you feel that you could talk to your doctor about it if you needed to?

If air quality is bad, say on a particular day, or in a particular place, what do you do about it?
(What can people do if they think air quality is particularly bad?)

Do you ever use anything to look up what air quality is like or is going to be like?
(For example forecasts or teletext?)

Do you think anything should be done about air pollution?
Who should be responsible for taking action?
What should they do?
Do you think anything will be done?

I'd like to ask you a few questions about your local authority (Barnet Council).
Do you have much to do with them?
What do you think of them?

Do you know that the council are responsible for monitoring and for controlling air quality in the borough? They have drawn up an Air Quality Strategy and starting now have to implement policies to make sure that the air quality in the borough does not get too bad.
Did you know about this?

How do you feel about them doing this?
Do you think it will be successful?
Why do you say that?
We have talked quite a lot about air pollution outside. Do you ever think about air pollution or air quality in any other situation?
Prompt: for instance inside buildings, at home or at work. Do you think this is ever a problem? Which do you think is most important?

How important do you think air pollution is, as an issue generally?
How important is it to you personally?

APPENDIX 3: RECRUITMENT LETTERS FOR THE IN-DEPTH INTERVIEWS

DEPARTMENT OF GEOGRAPHY

//www.geog.ucl.ac.uk

University College London UCL
26 Bedford Way • London • WC1H 0AP
Tel: 020 7679 2000 • Fax: 020 7679 7565

Dear Householder,

I am a researcher from the Department of Geography at University College London. I am currently carrying out some research in the borough of Barnet, looking at how people feel about their local environment, and how they think it affects their health and wellbeing.

This is an independent project, which is funded by the Economic and Social Research Council, but the results of the research will go to Barnet Borough Council as well as other bodies, and so will potentially have an impact on local policy-making.

For the first stage of the project, I need to talk to local people about their experiences and thoughts about particular aspects of their day to day environment. This will involve very informal 'interviews' with individuals from different areas of the borough, in order to understand their points of view.

I am particularly interested in talking to people from your area about this, and I am looking for people who would be willing to take part. What it would involve is an informal chat, lasting about 45 minutes to an hour. You don't need any particular knowledge or experience to take part, as I want to talk to different people about their own experiences and views.

Interviews can be arranged at a time and place to suit you, and I will pay you £20 as an acknowledgement of your time and trouble, or else make an equivalent donation to charity, if you prefer.

Let me assure you again that I am not working on behalf of any company, and I will not be trying to sell you anything. Interviews are anonymous, and I will not pass on information or details about you to anyone else.

If you think you might be willing to take part in my research, or if you'd like to ask me any questions, please contact me, Rosie Day, on one of the following numbers:

Department: 020 7679 5527
Mobile: 07815 616690

Or email me at r.day@ucl.ac.uk

This should be a very interesting project, and I do hope you will be able to help with it.

Yours sincerely,

Rosie Day

DEPARTMENT OF GEOGRAPHY

://www.geog.ucl.ac.uk

University College London UCL
26 Bedford Way • London • WC1H 0AP
Tel: 020 7679 2000 • Fax: 020 7679 7565

Dear Householder,

People wanted for paid interviews

I am a researcher from the Department of Geography at University College London. I am currently carrying out some research in the borough of Barnet, looking at how people feel about their local environment, and how they think it affects their health and wellbeing.

I am very interested in talking to people from your area about this, and I am looking for people who would be willing to take part. What it would involve is an informal chat, lasting about 45 minutes to an hour. You don't need any particular knowledge or experience to take part, as I want to talk to different people about their own experiences and views.

Interviews can be arranged at a time and place to suit you, and I will pay you £20 for your time, or else give £20 to charity if you prefer.

I am not working on behalf of any company, and I will not be trying to sell you anything. Interviews are anonymous, and I will not pass on information or details about you to anyone else. The results of the research will be reported to Barnet Council, among others, so this is a chance put across your point of view.

If you think you might be willing to take part in my research, or if you'd like to ask me any questions, please contact me, Rosie Day, on one of the following numbers:

Work: 020 7679 5527
Mobile: 07815 616690

Or email me at r.day@ucl.ac.uk

I hope you will be able to help with this project.

Yours sincerely,

Rosie Day

APPENDIX 4: LIST OF CODES USED FOR ANALYSIS OF THE IN-DEPTH INTERVIEWS

action / inaction - personal
agency
air poll - blame
air poll - importance generally
air poll - importance personally
air poll - noticing
air poll - rationale
air poll - reasons for action / inaction
air poll - responsibility
air poll - solutions
air poll effects non health
air poll explanation - London
air poll explanation general
air poll explanation local
air poll health effects - close others
air poll health effects - general
air poll health effects - personal
air poll indoors
air, local
air/env comparative
area description - neutral
area description - positive
area health
area problems
choices about where to live
council
council - air quality strategy
doctors
driving
env problems/risk general
experts
forecasts
government
health risks general
indoor / outdoor importance
knowledge - self
London environment
media
personal
problem rationale
problems - mitigating factors
problems, general
public knowledge
public transport
smoking
solutions/improvements general
trees/greenery

APPENDIX 5: THE QUESTIONNAIRE

SECTION 1 – WHERE YOU LIVE

1. Overall, how happy are you with your neighbourhood as a place to live?
Please answer by circling one of the numbers on the 1 to 7 scale below, where 1 means 'very unhappy' and 7 means 'very happy'.

Very unhappy	Quite unhappy	Slightly unhappy	Neither unhappy nor happy	Slightly happy	Quite happy	Very happy
1	2	3	4	5	6	7

2. Below is a list of possible problems people have in the places where they live. We would like to know how much of a problem you think each of these is in YOUR neighbourhood.
For each item listed in the left hand column, please read across the line and circle one of the numbers from 1 to 5, where 1 means you think it is not a problem at all, and 5 means you think it is a very big problem. If you can't answer, tick the 'don't know' box.

	Not a problem at all	A slight problem	A moderate problem	A fairly big problem	A very big problem	Don't know
Litter	1	2	3	4	5	☐
Graffiti	1	2	3	4	5	☐
Vandalism	1	2	3	4	5	☐
Mugging / personal attack	1	2	3	4	5	☐
Burglary	1	2	3	4	5	☐
Drugs	1	2	3	4	5	☐
Unemployment	1	2	3	4	5	☐
Traffic congestion	1	2	3	4	5	☐
Noise	1	2	3	4	5	☐
Air pollution	1	2	3	4	5	☐
Road safety	1	2	3	4	5	☐
Parking	1	2	3	4	5	☐
Housing conditions	1	2	3	4	5	☐
Poverty	1	2	3	4	5	☐
Anything else you would like to add (please say what)	1	2	3	4	5	☐

SECTION 2 – QUESTIONS ABOUT AIR QUALITY

3. How good or bad do YOU feel the air is in the neighbourhood where you live?
Please circle one of the numbers from 1 to 7, or if you can't answer, tick 'don't know'.

Extremely bad	Very bad	Quite bad	Neither good nor bad	Quite good	Very good	Extremely good	Don't know
1	2	3	4	5	6	7	☐

4. How good or bad do YOU feel the air is in Central London?

Extremely bad	Very bad	Quite bad	Neither good nor bad	Quite good	Very good	Extremely good	Don't know
1	2	3	4	5	6	7	☐

5. Below is a list of things that sometimes cause air pollution. We would like to know how much air pollution YOU think each of these things causes IN THE NEIGHBOURHOOD WHERE YOU LIVE.
For each item listed, please read across and circle a number from 1 to 5, where 1 means you think it causes no air pollution locally, and 5 means you think it causes a very large amount of air pollution locally. If you can't answer, tick the 'don't know' box.

	Causes no air pollution locally	Causes a little air pollution locally	Causes a moderate amount of air pollution locally	Causes quite a large amount of air pollution locally	Causes a very large amount of air pollution locally	Don't know
onfires	1	2	3	4	5	☐
uses	1	2	3	4	5	☐
uilding / roadworks	1	2	3	4	5	☐
;ars	1	2	3	4	5	☐
ıdustry	1	2	3	4	5	☐
ir traffic/planes	1	2	3	4	5	☐
orries/HGVs	1	2	3	4	5	☐
'omestic heating	1	2	3	4	5	☐
/eather	1	2	3	4	5	☐
ollen	1	2	3	4	5	☐
)ther (say what)	1	2	3	4	5	☐

6. Now we would like to know how much YOU think each of these things causes air pollution IN CENTRAL LONDON.

	Causes no air pollution in Central London	Causes a little air pollution in Central London	Causes moderate air pollution in Central London	Causes quite a large amount of air pollution in London	Causes a very large amount of air pollution in London	Don't know
Bonfires	1	2	3	4	5	☐
Buses	1	2	3	4	5	☐
Building / roadworks	1	2	3	4	5	☐
Cars	1	2	3	4	5	☐
Industry	1	2	3	4	5	☐
Air traffic/planes	1	2	3	4	5	☐
Lorries/HGVs	1	2	3	4	5	☐
Domestic heating	1	2	3	4	5	☐
Weather	1	2	3	4	5	☐
Pollen	1	2	3	4	5	☐
Other (please say what)	1	2	3	4	5	☐

SECTION 3. THE EFFECTS OF AIR QUALITY

7. Below is a list of health problems that some people have suggested might be connected with air pollution.
First of all, we would like to know if you think air pollution could CAUSE any of these illnesses to occur IN SOMEONE WHO DID NOT HAVE IT ALREADY. (We are interested in your opinion, so there is no right or wrong answer.)
For each illness on the list, **please read across and tick the box to say whether you think air pollution can *cause* the illness, air pollution cannot cause it, or don't know.**

	Air pollution **CAN cause it**	Air pollution **CANNOT cause it**	**Don't know**
Asthma	☐	☐	☐
Bronchitis	☐	☐	☐
Other lung / chest problems	☐	☐	☐
Cancer	☐	☐	☐
Heart disease	☐	☐	☐
Memory problems / Alzheimer's	☐	☐	☐

	Air pollution CAN cause it	Air pollution CANNOT cause it	Don't know
Hayfever / sneezing allergies	☐	☐	☐
Skin problems / eczema	☐	☐	☐
Other (please say what)	☐	☐	☐

8. Some people also think that air pollution can make certain health problems worse, even if it does not cause them.
How much do you think each of these problems could be affected by air pollution? For each illness on the list, please circle your answer on the scale of 1 to 5, or tick 'don't know'.

	No effect	A small effect	A moderate effect	A quite big effect	A very big effect	Don't know
Asthma	1	2	3	4	5	☐
Bronchitis	1	2	3	4	5	☐
Other lung/chest problems	1	2	3	4	5	☐
Cancer	1	2	3	4	5	☐
Heart disease	1	2	3	4	5	☐
Memory problems/ Alzheimers	1	2	3	4	5	☐
Hayfever/ sneezing allergies	1	2	3	4	5	☐
Skin problems / eczema	1	2	3	4	5	☐
Other (say what)	1	2	3	4	5	☐

9. How important do you think everyday air quality is for the health of people in general? Circle a number

Not important at all	Not very important	Fairly important	Very important	Essential	Don't know
1	2	3	4	5	☐

10. How important do you think the quality of YOUR everyday air is for YOUR health?

Not important at all	Not very important	Fairly important	Very important	Essential	Don't know
1	2	3	4	5	☐

11a. Do you, or have you ever, suffered from any illness or health problem that you think was *caused* by air pollution?
Please circle one of the answers.

Yes No Don't know

11b. If you answered yes, can you say what? ....

....

12a. Do you, or have you ever, suffered from any illness or health problem that you think is made worse by air pollution?
Please circle one of the answers.

Yes No Don't know

12b. If you answered yes, can you say what kind health problem it is?..........................

....

12c. How much do you think air pollution affects this problem? (if you said no to question 12a, you do not need to answer this question).

No effect	A little effect	A moderate effect	A quite big effect	A very big effect
1	2	3	4	5

13a. Do you think that air pollution affects the health of any of your family or friends?

Yes No Don't know

13b. If you said yes, could you say how it affects them?...

....

14. Does air pollution affect you in any other way apart from your health?
If you think it does, please say briefly how it affects you.

....

....

15. Some people have suggested the following actions that they might take if they think air quality outside is bad.
How often do you do any of the following due to air pollution?
Please read across and circle a number from 1 to 5, where 1 = never and 5 = always.

	Never	**Occasionally**	**Sometimes**	**Often**	**Always**
Avoid going out	1	2	3	4	5
Keep windows closed	1	2	3	4	5
Take medication such as antihistamines/ asthma inhaler	1	2	3	4	5
Don't hang washing out	1	2	3	4	5
Wear a mask	1	2	3	4	5
Complain to council or other	1	2	3	4	5
Avoid main roads	1	2	3	4	5
Drive rather than walk	1	2	3	4	5
Other (please say what)	1	2	3	4	5

SECTION 4. OPTIONS FOR MANAGING AIR POLLUTION

16. Below is a list of suggestions that people have made for how air pollution may be controlled.
Please say how good an option you think each one is, as a way of controlling air pollution.

	Very bad option	**Quite bad option**	**Neither good nor bad option**	**Quite good option**	**Very good option**	**Don't know**
Cleaner fuels	1	2	3	4	5	☐
Restrictions on car driving, e.g. not allowed certain days/times	1	2	3	4	5	☐
Public education	1	2	3	4	5	☐
Fines on polluting industries	1	2	3	4	5	☐
Better car technology, e.g. more efficient engines	1	2	3	4	5	☐
Better public transport	1	2	3	4	5	☐

	Very bad option	Quite bad option	Neither good nor bad option	Quite good option	Very good option	Don't know
Fines on polluting vehicles	1	2	3	4	5	☐
Higher petrol prices	1	2	3	4	5	☐
Planting more trees in polluted areas	1	2	3	4	5	☐
Charging to drive into congested areas e.g. central London	1	2	3	4	5	☐
Pedestrianising more places e.g. shopping areas	1	2	3	4	5	☐
Other (please say what)	1	2	3	4	5	☐

17. Below is a list of organisations or people who could have some responsibility for controlling air pollution.
How much responsibility do you think each of these SHOULD take for controlling air pollution?

	No responsibility	A little responsibility	Some responsibility	Quite a lot of responsibility	Very much responsibility	Don't know
Car manufacturers	1	2	3	4	5	☐
Other business / industry	1	2	3	4	5	☐
Central government	1	2	3	4	5	☐
Local councils e.g. Barnet council	1	2	3	4	5	☐
The Mayor of London / G.L.A	1	2	3	4	5	☐
World leaders	1	2	3	4	5	☐
The European Community (E.C.)	1	2	3	4	5	☐
The public	1	2	3	4	5	☐
Yourself	1	2	3	4	5	☐
Other (say who)	1	2	3	4	5	☐

18. And how much would you trust each of these organisations or people to do whatever was needed to control air pollution?

	Would not trust at all	Would trust a little	Would trust a fair amount	Would trust a lot	Would trust completely	Don't know
Car manufacturers	1	2	3	4	5	☐
Other business / industry	1	2	3	4	5	☐
Central government	1	2	3	4	5	☐
Local councils e.g. Barnet council	1	2	3	4	5	☐
The Mayor of London / G.L.A	1	2	3	4	5	☐
World leaders	1	2	3	4	5	☐
The European Community (E.C.)	1	2	3	4	5	☐
The public	1	2	3	4	5	☐
Yourself	1	2	3	4	5	☐
Other (please say who)	1	2	3	4	5	☐

SECTION 5: KNOWLEDGE AND INFORMATION ABOUT AIR POLLUTION

19. Where, if anywhere, have you heard or read anything about air pollution?

....

....

20a. Do you think you can tell when air quality is bad? Please circle your answer.

Yes, always Sometimes No, never Don't know

20b. If you said 'always' or 'sometimes', can you say briefly how you can tell?

....

....

21. How often do you use each of the following to know how good or bad the air is? Please circle a number for each item on the left.

	Never	Occasionally	Sometimes	Often	Always
Newspaper forecast	1	2	3	4	5
TV weather forecast	1	2	3	4	5
Radio weather forecast	1	2	3	4	5
Own experience / knowledge	1	2	3	4	5
Teletext	1	2	3	4	5
Other (please say what) …………………………	1	2	3	4	5

22. Do you feel that you know as much as you want to about air pollution and what its effects might be? Please circle your answer.

Yes   No   Don't know

23. Do you think that scientists and experts know enough about air pollution and what its effects might be? Please circle your answer.

Yes   No   Don't know

24. Do you think that people in general know enough about air pollution and what its effects might be? Please circle your answer.

Yes   No   Don't know

25. Who would you trust to give you reliable information about air pollution and its effects?
Circle a number for each one listed on the left, or tick 'don't know'.

	Would not trust at all	Would trust a little	Would trust a fair amount	Would trust a lot	Would trust completely	Don't know
University scientists	1	2	3	4	5	☐
Government scientists	1	2	3	4	5	☐
Central government	1	2	3	4	5	☐
Businesses / industry	1	2	3	4	5	☐
Barnet council	1	2	3	4	5	☐

	Would not trust at all	Would trust a little	Would trust a fair amount	Would trust a lot	Would trust completely	Don't know
Environmental groups	1	2	3	4	5	☐
Friends / family	1	2	3	4	5	☐
Your doctor	1	2	3	4	5	☐
Newspapers / TV	1	2	3	4	5	☐
Other (say who)	1	2	3	4	5	☐

26. If you think people should have more information about air pollution and its effects, do you have any ideas as to how you would like this to be given?

....

....

....

27. Do you think the public should be actively involved in deciding what is done about air pollution? Please tick ONLY ONE of the answers

The public should be actively involved in deciding what is done	☐
The public should be asked their views but not actively involved in deciding	☐
The public should not be asked their views nor involved in deciding	☐
Don't know	☐

Barnet Council is responsible for monitoring and managing air quality in the borough of Barnet. In spring 2001 they declared the whole of the borough an Air Quality Management Area. This means that throughout the borough they will be monitoring air pollution levels and introducing an action plan to help reduce pollution levels to government targets by 2005. This is their local air quality strategy.

28. Have you heard anything about Barnet's air quality strategy? circle your answer

Yes No Don't know

29. How good an idea do you think a local air quality strategy is?

A very bad idea	A quite bad idea	Neither bad nor good idea	A quite good idea	A very good idea	Don't know
1	2	3	4	5	☐

30. How likely do you think it is that local air quality will improve in the near future?

Very unlikely to improve	Quite unlikely to improve	Neither unlikely nor likely	Quite likely to improve	Very likely to improve	Don't know
1	2	3	4	5	☐

SECTION 6: SOME OPINIONS

31. Please say how much you agree or disagree with the following statements. Circle your answer on the 1 to 5 scale where 1 = disagree strongly and 5 = agree strongly

	Disagree strongly	Disagree	Neither agree nor disagree	Agree	Agree strongly
I think that air pollution is a problem on a world wide scale	1	2	3	4	5
I worry about the effects of air pollution on my health	1	2	3	4	5
I think something needs to be done about air pollution in London	1	2	3	4	5
I don't worry about air pollution because I can't do anything about it	1	2	3	4	5
Most people are too busy to worry about air pollution	1	2	3	4	5
I think the air in my neighbourhood needs to be improved	1	2	3	4	5
I feel well informed about air pollution and its effects	1	2	3	4	5
I worry about how air pollution might affect other people	1	2	3	4	5
I am concerned about the long term effects of air pollution on the environment	1	2	3	4	5
Nothing can be done about air pollution	1	2	3	4	5

SECTION 7: INFORMATION ABOUT YOU

All information is confidential and anonymous, and will not be associated with your address, but if there are any questions you really do not wish to answer, please leave them blank and fill in the rest.

32. Are you: (please tick one)

Male ☐ Female ☐

33. Which age group do you belong to? Please tick one box

16-19 ☐
20-29 ☐
30-39 ☐
40-49 ☐
50-59 ☐
60-69 ☐
70 and over ☐

34. How would you describe your ethnic group?

....

35. Which of the following educational qualifications do you have? Please tick as many as apply to you.

None ☐
GCSEs or equivalent ☐
A levels or equivalent ☐
HNC / HND ☐
University degree or equivalent ☐
Other(s) – please say what ☐

....

36. Could you say roughly what is your total household income before tax, including benefits and pensions? Please tick one box

£0-9999 per year, or £0 - 192 per week ☐
£10,000 – 19,999 per year or £193 - 385 per week ☐
£20,000 – 29,999 per year or £386 - 577 per week ☐
£30,000 – 39,999 per year or £578 – 769 per week ☐
£40,000 – 49,999 per year or £770 – 962 per week ☐
£50,000 – 59,999 per year or £963 – 1154 per week ☐
£60,000+ per year, or £1155+ per week. ☐

37. How many people are in your household? ....

38. Are you: (please tick one)

In full time paid employment ☐
in part time paid employment ☐
not in paid employment at present ☐

39. What is your main job or occupation?

....

40. Do you have children under 16? Please circle

Yes No

41. Which newspaper(s) have you read regularly in the last month?

....

42. Roughly how many hours of TV do you watch a day? (on average). Please circle one answer

None under 1 hr 1hr 2hrs 3hrs 4hrs 5+ hrs

43. Do you drive? Please circle your answer

Yes No, I can't No, but I can

44. How many cars or vans does your household own in total? ....

45. What is your main mode of transport in London? ....

46. Do you suffer from any of the following? (please tick all that apply)

Asthma ☐

Hayfever or allergic rhinitis ☐

Other lung or chest disorder ☐

Eczema or other skin irritations ☐

Heart problems ☐

47. How long have you lived in your current neighbourhood? ....

48. What is the name of the road that you live on? ....

49. Do you have a garden? Please circle

Yes No

50. How would you rate the traffic flow on your road? Please circle

Light Medium Heavy

If you would like to be entered into the prize draw, please write a contact name (first name will do) and phone number or address here:

If you would like to add anything or make any comments about this questionnaire, please use this space.

THANK YOU VERY MUCH FOR YOUR HELP – IT IS MOST APPRECIATED!

APPENDIX 6: COVERING LETTER & EXTRA INSTRUCTIONS FOR THE QUESTIONNAIRE

DEPARTMENT OF GEOGRAPHY

):/www.geog.ucl.ac.uk

University College London UCL

26 Bedford Way • London • WC1H 0AP
Tel: 020 7679 2000 • Fax: 020 7679 7565

Dear «Name»,

Air Quality Questionnaire – win £100

I am a researcher from the Department of Geography at University College London, and I'm working on a project in the borough of Barnet, investigating people's views on air pollution.

I'm particularly interested in the views of people in your area, so I'm sending a copy of the enclosed questionnaire to adults on the electoral register in your neighbourhood, and asking them to fill it in.

The questions are all about your point of view. I want to know what people think, so there aren't any right or wrong answers, and it isn't a test of how much you know.

I realise that I'm asking you to give up some time, so as an extra incentive, everyone who sends back a completed questionnaire will be entered into a prize draw to win £100.

It's also your chance to give your views on your air quality to the people who will make decisions about what happens in London and in your area. The results of the research will go to Barnet Council and to other organisations responsible for air quality policy, so let them know what you think.

My research is independent and sponsored by a research council. I have no connections with any business interests and I will not be trying to sell you anything. All the information in the questionnaires is confidential and will not be passed on to anyone else. Your full name and address do not need to be given, and I will not need to contact you again unless you win the prize draw.

I would very much appreciate it if you could fill in the questionnaire and send it back to me in the next two weeks. I've enclosed a reply paid envelope so you don't need a stamp.

If you have any queries, please feel free to phone me, Rosie Day, on 020 7679 5527, or on 07815 616690.

Thank you very much for your help!

QUESTIONNAIRE

All information is confidential.

- The questions are about what YOU think, so there are no right or wrong answers.

- You don't need to spend too much time thinking about any of the questions, just answer what you immediately think.

- If there are any questions you can't answer, or really don't want to answer, leave them blank.

THANK YOU FOR YOUR TIME!

APPENDIX 7: REMINDER LETTER FOR THE QUESTIONNAIRE RECIPIENTS

DEPARTMENT OF GEOGRAPHY

p://www.geog.ucl.ac.uk

University College London UCL

26 Bedford Way • London • WC1H 0AP
Tel: 020 7679 2000 • Fax: 020 7679 7565

Dear household,

A couple of weeks ago I sent out a questionnaire about air quality to people in your neighbourhood.

The adults in your household should all have been sent a copy, but if you didn't receive one and you would like to fill one in, please let me know and I'll send you a copy.

If you received the questionnaire, I would really appreciate it if you could spare some time to fill it in and send it back in the reply paid envelope. The results of my research will be reported directly to local policy makers, and the more people that respond, the better and more comprehensive the results will be. Don't forget that you could also win £100.

If you have already sent a completed questionnaire back, please accept my apologies for troubling you again.

If you have any queries, please call me on 020 7679 5527, or 07815 616690 (mobile).

Thank you for your help,

Rosie Day

APPENDIX 8: SOCIAL AND DEMOGRAPHIC CHARACTERISTICS OF THE SURVEY RESPONDENTS IN THE FOUR STUDY AREAS AND OF THE WHOLE SAMPLE

Totteridge

Total sample = 54

Gender	50% male	49% female	1.9% missing (1.9%)

Age	3.7%	16-19
	5.6%	20-29
	9.3%	30-39
	27.8%	40-49
	22.2%	50-59
	20.4%	60-69
	11.1%	70+
Ethnicity (self described)	27.2%	white
	3.7%	Jewish
	1.9%	black African
	1.9%	Indian / Pakistani / Bangladeshi
	20.4%	missing data
Educational attainment	1.9%	no qualifications
	13%	GCSE or equivalent
	35.2%	A level
	5.6%	HNC / HND or similar
	37.0%	degree
	5.6%	postgraduate qualification
	1.9%	missing data
Income	3.7%	0-9999 p.a.
	14.8%	£10,000-19,999
	3.7%	£20,000-29,999
	11.1%	£30,000-39,999
	5.6%	£40,000-49,999
	9.3%	£50,000-59,999
	13.0%	60,000+
	38.9%	missing data
Employment	31.5 %	full-time employed
	29.6%	part-time employed
	33.3%	not in employment
	5.6%	missing data
Occupation	22.2%	retired
	9.3%	student / unemployed / homemaker

	0.0%	unskilled
	20.4%	skilled manual/ nursing/ clerical/ sales
	29.6%	professional / management
	18.5%	missing data
Children under 16	61.1%	no
	37.0%	yes
	1.9%	missing
Number in household	7.8%	1
	24.1%	2
	35.2%	3
	9.3%	4
	16.7%	5
	1.9%	7
	5.6%	missing data

Newspapers read most popular are: Telegraph / Sunday Telegraph (27.7%), Daily Mail (25.9%), Times / Sunday Times (22.2%). 11.1% not answered / none.

Hours TV watched	3.7%	none
	12.9%	0.5 hrs (daily average)
	27.7%	1 hr
	31.5%	2 hrs
	11.1%	3 hrs
	11.1%	4hrs
	1.85%	5+hrs
Driving	87%	drive,
	7.4%	do not drive,
	5.6%	do not but can.
Number of cars in household	3.7%	none
	33.3%	1 car
	50.0%	2 cars
	9.3%	3 cars
	1.9%	4 cars
	1.9%	missing data
Main mode of transport in London	35.2%	car
	48.1%	tube
	11.1%	bus
	1.9%	train
	3.7%	missing

Health conditions	14.8%	asthma
(personally)	5.6%	other lung/chest problem
	3.7%	heart disease
	16.7%	hayfever / rhinitis
	11.1%	eczema / skin problems
	35.2%	any of above

Hampstead Garden Suburb

Total 55 respondents.

Gender	43.6% male	56.4% female
Age	1.8%	16-19
	18.2%	20-29
	21.8%	30-39
	12.7%	40-49
	18.2%	50-59
	12.75%	60-69
	14.5%	70+
Ethnicity	60%	white
	5.5%	Jewish
	5.5%	Indian / Pakistani / Bangladeshi
	1.8%	Middle Eastern
	1.8%	Far Eastern
	25.5%	missing data
Educational attainment	1.8%	none
(highest achieved)	7.3%	GCSE
	10.9%	A level
	12.7%	HND / HNC etc
	49.1%	degree
	10.9%	postgraduate
	7.3%	missing
Income	10.9%	£0-9999 p.a.
	10.9%	£10,000-19,999
	5.5%	£20,000-29,999
	10.9%	£30,000-39,999
	7.3%	£40,000-49,999
	3.6%	£50,000-59,999
	25.5%	£60,000+
	23.6%	missing data
Employment	41.8%	full-time
	16.4%	part-time
	34.5%	not working
	7.3%	missing
Occupation	18.2%	retired
	12.7%	student / unemployed / homemaker
	0.0%	unskilled
	20.0%	skilled manual / nursing / clerical / sales
	38.2%	professional / management
	10.9%	missing data

Children under 16	25.5% yes	
	72.2% no	
	1.8% missing data	
Number in household	20.0%	1
	27.3%	2
	20.0%	3
	21.8%	4
	1.8%	6
	9.1%	missing data

Newspapers read Most popular are Times / Sunday Times (38.1%), Daily Mail (20.0%) and Guardian / Observer (18.1%). 12.7% not answered / none.

Hours TV watched (daily average)	18.2%	0.5 hrs
	12.7%	1 hr
	25.5%	2 hrs
	21.8%	3 hrs
	12.7%	4 hrs
	7.3%	5+ hrs
	1.8%	missing data
Driving	78.2% drive	
	5.5% cannot drive	
	14.5% do not drive but can.	
Number of cars per household	12.7%	none
	40%	1 car
	25.5%	2 cars
	12.7%	3 cars
	9.1%	missing data
Main mode of transport in London	49.1%	car
	21.8%	tube
	20.0%	bus
	1.8%	walk
	1.8%	cycle
	1.8%	taxi
	3.6%	missing data
Health Conditions (personally suffer)	18.2%	asthma
	9.1% o	other lung /chest complaint
	5.5%	heart disease
	38.2%	hayfever /rhinitis
	18.2%	eczema /skin problems
	58.2%	any of above

Brent Cross

Total 36 respondents

Gender 33.3% male 62.9% female 2.8% missing

Age	0%	16-19
	8.3%	20-29
	25.0%	30-39
	19.4%	40-49
	5.6%	50-59
	13.9%	60-69
	27.8%	70+
Ethnicity	61%	white
	5.6%	black unspecific
	2.8%	afro-Caribbean
	0.6%	missing data
Educational attainment	38.9%	none
	22.2%	GCSE
	11.1%	A level
	2.8%	HND etc
	13.9%	degree
	0%	postgraduate
	11.1%	missing data
Income	30.6%	£0-9999 p.a.
	36.1%	£10,000-19,999
	11.1%	£20,000-29,999
	2.8%	£30,000-39,999
	2.8%	£40,000-49,999
	0%	£50,000-59,999
	0%	£60,000+
	16.7%	missing data
Employment	30.6%	full-time
	11.1%	part-time
	47.2%	not employed
	11.1%	missing
Occupation	30.6%	retired
	8.3%	student / unemployed / homemaker
	11.1%	unskilled
	22.2%	skilled manual / nursing / clerical / sales
	11.1%	professional / management
	16.7%	missing data

Children under 16	33.3%	yes
	61.1%	no
	5.6%	missing data
Number in household	27.8%	1
	27.8%	2
	19.4%	3
	5.6%	4
	11.1%	5
	8.3%	missing data

Newspapers read Most popular are Sun (25%), News of World (16.6%), Mirror (13.8%), Daily Mail (13.8%). 16.6% no answer / none.

Hours TV Watched (daily average)	8.3%	0.5 hrs
	13.9%	1 hr
	22.2%	2 hrs
	16.7%	3 hrs
	22.2%	4 hrs
	13.9%	5+ hrs
	2.8%	missing
Driving	33.3%	drive
	44.4%	cannot
	19.4%	don't but can
	2.8%	missing
Main mode of transport	19.4%	car
	5.6%	tube
	66.7%	bus
	2.8%	motorbike / scooter
	5.6%	missing data
Health Conditions	13.9%	asthma
	11.1%	other lung/chest problem
	16.7%	heart disease
	33.3%	hayfever/rhinitis
	22.2%	eczema/skin problems
	61.1%	any of above

Grahame Park

Total 55 respondents

Gender	36.4% male	61.8% female	1.8% missing

Age	0%	16-19
	7.3%	20-29
	20.0%	30-39
	16.4%	40-49
	14.5%	50-59
	21.8%	60-69
	20.0%	70+
Ethnicity	52.7%	white
	7.3%	black African
	3.6%	black unspecific
	3.6%	afro-Caribbean
	1.8%	Jewish
	30.9%	missing data
Educational attainment	29.1%	none
(highest achieved)	27.3%	GCSE
	9.1%	A level
	5.5%	HND etc
	14.5%	degree
	0.0%	postgraduate
	14.5%	missing
Income	38.2%	£0-9999 p.a.
	12.7%	£10,000-19,999
	18.2%	£20,000-29,999
	9.1%	£30,000-39,999
	1.8%	£40,000-49,999
	0%	£50,000-59,999
	0%	£60,000+
	20%	missing data
Employment	30.9%	full-time
	10.9%	part-time
	56.4%	not employed
	1.8%	missing
Occupation	32.7%	retired
	14.5%	student / unemployed / homemaker
	9.1%	unskilled
	32.7%	skilled manual / nursing / clerical / sales
	5.5%	professional / management
	5.5%	missing data

Children under 16	34.5% yes	65.5% no
Number in household	23.6%	1
	27.3%	2
	23.6%	3
	14.5%	4
	7.3%	5
	3.6%	missing data

Newspapers read Most popular are Mirror (34.5%), Sun (32.7%), Daily Mail (23.6%). 12.7% no answer or none.

Hours TV watched (daily average)	1.8%	0 hrs
	5.5%	0.5 hrs
	3.6%	1 hr
	21.8%	2 hrs
	32.7%	3 hrs
	12.7%	4 hrs
	20.0%	5+ hrs
	1.8%	missing
Driving	45.5%	drive
	30.9%	cannot
	21.8%	don't but can
	1.8%	missing
Number of cars per household	32.7%	none
	49.1%	1 car
	10.9%	2 cars
	5.5%	3 cars
	1.8%	missing data
Main mode of Transport	21.8%	car
	27.3%	tube
	43.6%	bus
	1.8%	train
	1.8%	walk
	1.8%	motorbike/scooter
	1.8%	cycle
Health conditions	21.8%	(highest) asthma
	9.1%	other lung/chest problem
	10.9%	heart disease
	27.3%	hayfever/rhinitis
	20.0%	eczema/skin problems
	58.2%	any of above

Whole sample

Total 200 respondents

Gender	41.5% male	57% female	1.5% missing

Age	1.5%	16-19
	10.0%	20-29
	18.5%	30-39
	19.0%	40-49
	16.0%	50-59
	17.5%	60-69
	17.5%	70+
Ethnicity	61.5%	white
(self described)	3.0%	Jewish
	2.5%	black African
	2.0%	Indian / Pakistani / Bangladeshi
	2.0%	black unspecific
	1.5%	Afro-Caribbean
	0.5%	Middle Eastern
	0.5%	East Asian
	26.5%	missing data
Educational attainment	16.0%	none
(highest achieved)	17.0%	GCSE
	17.0%	A level
	7.0%	HND etc
	30.0%	degree
	4.5%	postgraduate
	8.5%	missing
Income	20.0%	£0-9999 p.a.
	17.0%	£10,000-19,999
	9.5%	£20,000-29,999
	9.0%	£30,000-39,999
	4.5%	£40,000-49,999
	3.5%	£50,000-59,999
	10.5%	£60,000+
	25.5%	missing data
Employment	34.0%	full-time
	17.5%	part-time
	42.5%	not employed
	6.0%	missing

Occupation	25.5%	retired
	11.5%	student / unemployed / homemaker
	4.5%	unskilled
	24.0%	skilled manual / nursing / clerical / sales
	22.0%	professional / management
	12.5%	missing data

Children under 16 32.5% yes 65.5% no 2% missing data

Number in household	19.0%	1
	26.5%	2
	25.0%	3
	13.5%	4
	8.5%	5
	0.5%	6
	0.5%	7
	6.5%	missing data
Newspapers read	9.5%	Guardian / Observer
	19%	Times / Sunday Times
	11%	Telegraph / Sunday Telegraph
	6.5%	Independent
	21.5%	Daily Mail / Mail on Sunday
	18%	Sun / News of the World
	13%	Mirror
	4.5%	Evening Standard
	4%	local paper
	8%	Express
	0.5%	Jewish Chronicle
	4.5%	Metro
	0.5%	Star
	13.5%	none indicated
Hours TV watched (daily average)	1.5%	0 hrs
	11.5%	0.5 hrs
	14.5%	1 hr
	25.5%	2 hrs
	21.0%	3 hrs
	14.0%	4 hrs
	10.5%	5+ hrs
	1.5%	missing
Driving	63.5%	drive
	20.0%	cannot
	15.0%	don't but can
	1.5%	missing

Number of cars per household	22.0%	none
	39.5%	1 car
	25.5%	2 cars
	7.5%	3 cars
	0.5%	4 cars
	5.0%	missing data
Main mode of Transport	32.5%	car
	27.5%	tube
	32.5%	bus
	1.0%	train
	1.0%	walk
	1.0%	motorbike/scooter
	1.0%	cycle
	0.5%	taxi
Health conditions	17.5%	asthma
	8.5%	other lung/chest problem
	8.5%	heart disease
	28.5%	hayfever/rhinitis
	17.5%	eczema/skin problems
	53.0%	any of above

APPENDIX 9: KEY TO VARIABLES TABULATED IN CHAPTERS 4, 5 & 6.

Name/ abbreviation	Refers to	Binary/ category/ scale	Unit interpretation
gender	gender	binary	1 = female; 0 = male
age	age	scale	1 unit = 10 years
asthma	Having asthma	binary	1 = presence; 0 = absence
chestprob	Having chest problems other than asthma	binary	1 = presence; 0 = absence
heartprob	Having heart problems	binary	1 = presence; 0 = absence
hayfever	Having allergic rhinitis or hayfever	binary	1 = presence; 0 = absence
eczema	Having eczema	binary	1 = presence; 0 = absence
HGS	Hampstead Garden Suburb	binary	1 = lives there; 0 = does not
BX	Brent Cross	binary	1 = lives there; 0 = does not
GPK	Grahame Park	binary	1 = lives there; 0 = does not
localair	Rating of local air quality	scale	1 unit = 1 point on 7 point scale
Q2Phys	Composite variable relating to perceived physical problems in locality	scale	Higher values mean greater perceived problems. Z scores more useful as is composite variable.
Q2Soc	Composite variable relating to perceived social problems in locality	scale	Higher values mean greater perceived problems. Z scores more useful as is composite variable.
Car user	Using a car as main form of transport	binary	1 = uses mainly car; 0 = not